DEPARTMENTAL NOTES

ON

INSECTS THAT AFFECT FORESTRY,

BY

E. P. STEBBING, F.L.S., F.E.S.,
FOREST ENTOMOLOGIST AND LECTURER ON ZOOLOGY AT THE
IMPERIAL FOREST SCHOOL, DEHRA DUN.

1 - FEB 1903

No. 1.

CALCUTTA:
SUPERINTENDENT OF G[illegible]
190[illegible]

CALCUTTA:
GOVERNMENT OF INDIA CENTRAL PRINTING OFFICE.
8, HASTINGS STREET.

PREFACE.

THE object of issuing the Departmental Notes on Insects that affect forestry in India in their present form is to enable the Officers of the department and others interested in the culture of trees to keep up to date with our knowledge of the subject and to assist the advancement of the work by studying the still unknown portions of the life histories of the various pests detailed and of others still unrecorded. To this end, criticism and discussion are cordially invited.

Several of the insects dealt with are new to science and most of the information on their habits, etc., is new. It has not been considered necessary here, however, to give in full detail the reasons for the statements made with reference to some of the new and more complex of the life histories. The author hopes to publish elsewhere full and detailed technical papers dealing with the matter from the scientific standpoint.

It is proposed to give information in these notes upon :—

i.—Hurtful Insects.

ii.—Useful Insects.

E. P. STEBBING.

DEHRA DUN;

February 1902.

C…NNEM… 1- FEB. 1903 …UBLIC…

CONTENTS.

Alphabetical List of Trees, with names of Insects by which they are attacked.

Abies Webbiana, Lindl. Cone tunneller—*Phycita abietella,* pp. 108, 109.

Acacia Catechu, Willd. Wood-borer—*Sinoxylon crassum,* p. 12.

Adina cordifolia, Hook. Leaf-defoliator—*Dirades theclata,* p. 97.

Æsculus indica, Colebr. Leaf-defoliator—*Acronycta anædina,* p. 91.

Bambuseæ (species?). Seedling destroyers—*Tryxalis nasuta,* p. 1; *Oxya velox,* p. 4.

Careya arborea, Roxb. Leaf-defoliators—*Lymantria obsoleta,* pp. 68, 71; *Lymantria todara,* pp. 69, 71; *Lymantria mathura,* pp. 70, 71; *Lymantria bivittata,* p. 71.

Cassia Fistula, Linn. Pod-tunnellers—*Trachylepidea fructicasiella,* p. 105; *Cryptophlebia carpophaga,* p. 117.

Cassia orientalis, Linn. Pod-tunnellers—*Cryptophlebia carpophaga,* p. 117.

Castanea vesca, Gaertn. Seedling root-eater—*Elateridæ* (Click beetles), p. 89.

Cedrela serrata, Royle. Leaf-defoliator—*Acronycta anædina,* p. 91.

Cedrus Deodara, Loud. Bark-borer—*Scolytus* sp., p. 45. Wood-borers—*Buprestid* and *Longicorn larvæ,* p. 49. Seedling-destroyers—*Agrotis ypsilon,* p. 81; *Melolontha* or *Lachnosterna* sp. (White Grubs), p. 87. Seedling root-eater—*Elateridæ* (Click beetles), p. 89. Cone-tunnellers—*Euzophera cedrella,* pp. 107, 109; *Phycita abietella,* pp. 108, 109.

Dalbergia latifolia, Roxb. Wood-borer—*Sinoxylon anale,* p. 16.

Dalbergia Sissoo, Roxb. Wood-borers—*Sinoxylon crassum,* p. 12; *Sinoxylon anale,* p. 16. Leaf-defoliators—*Myllocerus* sp., p. 31; *Apoderus* sp., p. 33; *Plecoptera reflexa,* p. 94; *Ypsolophus* sp., p. 119. Sap-feeder—*Monophlebus dalbergiæ,* p. 142.

Dendrocalamus strictus, Nees. Seed-destroyer—*Ochrophara montana,* p. 123.

Diospyros melanoxylon, Roxb. Leaf galls—*Psylla obsoleta,* p. 130.

Eugenia Jambolana, Lam. Leaf-destroyer—*Aleurodes eugeniæ,* p. 132.

Ficus elastica, Roxb. Seedling-destroyer—*Brachytrupes achætinus* p. 6.

Ficus religiosa, Linn. Leaf-defoliator—*Lymantria ampla*, p. 67.

Grewia asiatica, Linn. Leaf-defoliator—*Mimastra cyanura*, p. 22.

Juglans regia, Linn. Nut-destroyer—*Alcides* sp., p. 38; Leaf-defoliator —*Acronycta anaedina*, p. 91.

Lagerströmia parviflora, Roxb. Leaf-defoliators—*Lymantria obsoleta*, pp. 68, 71; *Lymantria todara*, pp. 69, 71; *Lymantria mathura*, pp. 70, 71; *Lymantria bivittata*, p. 71.

Macaranga denticulata, Müll. Arg. Leaf-defoliators—*Lymantria obsoleta*, pp. 68, 71; *Lymantria todara*, pp. 69, 71; *Lymantria mathura*, pp. 70, 71; *Lymantria bivittata*, p. 71.

Mallotus philippinensis, Müll. Arg. Leaf-defoliator—*Serica Alcocki*, p. 10.

Morus indica, Linn. Wood-borer—*Apriona Germari*, p. 25. Sap-feeders—*Limnobiidæ*, p. 30.

Olea glandulifera, Wall. Sap-feeder—*Fiorinia theæ*, p. 133.

Parrotia Jacquemontiana, Dene. Leaf-defoliator—*Porthesia xanthorrhœa*, p. 78.

Picea Morinda, Link. Cone-tunnellers—*Euzophera cedrella*, pp. 107, 109; *Phycita abietella*, pp. 108, 109.

Pinus excelsa, Wall. Seedling-destroyers—*Tryxalis nasuta*, p. 1; *Oxya velox*, p. 4. Cone-tunneller—*Phycita abietella*, p. 108, 109.

Pinus Khasya, Royle. Bark and Wood-borer—*Cryptorhynchus* sp., p. 41; *Lepidopterous larvæ*, p. 44.

Pinus longifolia, Roxb. Leaf-defoliator—*Clania crameri*, p. 56.

Prosopis spicigera, Linn. Coppice shoot-destroyer—*Ceratopachys variabilis*, p. 126.

Quercus dilatata, Lindl. Wood-borer. *Xylotrechus vicinus*, p. 24.

Shorea robusta, Gaertn. Wood-borer—*Sinoxylon anale*, *p.* 16. Leaf-defoliators—*Suana concolor*, p. 58; *Trabala vishnu*, p. 61; *Dasychira* sp., p. 63; *Lymantria obsoleta*, pp. 68, 71; *Lymantria todara*, pp. 69, 71; *Lymantria mathura*, pp. 70, 71; *Lymantria bivittata*, p. 71; *Lymantria grandis*, p. 75; *Leucoma diaphana*, p. 80; *Boarmia selenaria*, p. 100; *Macalla moncusalis*, p. 113; *Tetridia caletoralis*, p. 115. Sap-feeder—*Monophlebus Stebbingii*, p. 135.

Tectona grandis, Linn. Seedling-destroyer—*Brachytrupes achætinus*, p. 6. Leaf-defoliators—*Pseudosphinx discistriga*, p. 52; *Dirades theclata*, p. 97; Sap-feeder—*Monophlebus tectonæ*, p. 145.

Terminalia belerica, Roxb. Leaf-defoliators—*Lymantria obsoleta*, pp. 68, 71; *Lymantria todara*, pp. 69, 71; *Lymantria mathura*, pp. 70, 71; *Lymantria bivittata*, p. 71.

Terminalia Chebula, Retz. Leaf-defoliators—*Lymantria obsoleta*, pp. 68, 71; *Lymantria todara*, pp. 69, 71; *Lymantria mathura*, pp. 70, 71; *Lymantria bivittata*, p. 71.

Terminalia tomentosa, W. & A. Leaf-defoliators—*Dasychira* sp. p. 63; *Lymantria obsoleta*, pp. 68, 71; *Lymantria todara*, pp. 69, 71; *Lymantria mathura*, pp. 70, 71; *Lymantria bivittata*, p. 71.

Xylia dolabriformis, Benth. Wood-borer—*Sinoxylon anale*, p. 16.

Predaceous Insects.

Teretriosoma Stebbingii, pp. 19, 20.
Teretriosoma cristatum, pp. 19, 20.
Teretriosoma intrusum, p. 20.
Bothrides sp., p. 21.
} Predaceous upon the wood-borers, *Sinoxylon crassum* and *Sinoxylon anale*.

Cleridæ larvæ, p. 49. Predaceous upon the bark-borer *Scolytus* sp.

Insecticides.

A Note on the application of Paris Green as an Insecticide for destroying caterpillars, p. 146.

Keys to Plates and Plates, p. 151, etc.

1 - FEB 1903
PUBLIC

TRYXALIS NASUTA,

FISCH.

References:—Fisch. Orth. Eur. 299, pl. 15, f. 1,2. Gryllus (Acrida) nasutus, Linn. Mus. Lud. 118-9; Syst. Nat. i. 2, 692. Rors. Ins. ii, pl. 4, fig. 1, 2. Gryllus turritus, De. Vill. Ent. Linn. i, 434, pl. 2, f. 4.

Classification:—Order, **ORTHOPTERA**. Family, Acridiidæ.

Description.

This insect varies a great deal in tint and in the distribution of the colouring except that of the antennæ and wings. The body is green or light reddish, glabrous and shining. Head with the upper portion in front of the eyes about an eighth of an inch long, anteriorly obtuse. Wings a little shorter than the tegmina (upper wings), transparent, yellowish, especially at their lower inside portions; the veins of the same colour. Under surface of the abdomen darker than the rest, a dull pink when the insect is alive, becoming brown on drying after death. Tarsi of the same colour as the body; the after tibiæ furnished for the lower two-thirds of their length with a double row of numerous fine spines. ♀. Head and prothorax often have longitudinal rays of green and red sometimes not plainly visible. The elytra, of all the parts of the body, vary most in colour; sometimes bright green all over, at others having a longitudinal dull stripe cut up by white blotches beneath this band there is sometimes a reddish one also present; ♂ with uniform green elytra. Length 2 to 2½ inches. Pl. VI, fig. 1, shows a side view of this insect.

Life History.

Very little is on record as to the life history of this locust as far as it affects our nurseries and forests. It appears to be full grown in July and August, as it is during these months that it has always been reported as doing damage both to crops and to young plants. For the other ten months of the year we have at present no data as to where it is to be found. Observations are needed as to the number of generations it

B

passes through during the year, where the eggs are laid and how long it spends in the young wingless larval stage.

Localities from which reported.

The distribution of the insect in India would appear to be a somewhat wide one. Madras and Bombay have reported the pest as causing considerable injury to crops. In 1897 the Deputy Conservator of Forests sent the locust from the Kangra Division in the Punjab, where it had increased in some numbers. In Madras it formed one of the locusts which gave so much trouble in the invasion of 1878. It, with several other species, probably breeds locally there as also in the other parts of the country it affects.

Mr. Mollison, now Inspector General of Agriculture, sent the insect from the Bombay Presidency, where it had injured crops in the vicinity of Poona in 1893. Next year it did injury in Satara. This insect is also common in the Cape of Good Hope, Senegal, Egypt.

Relations to the Forest.

This *Tryxalis* is said to have done considerable injury during the year 1897 to young plants of *Pinus excelsa* and bamboo (species?). Sowings of these species had apparently been made in various portions of the Kangra Division, and it was found that the locusts were biting off the young seedlings and either wholly or partially consuming them. The insect was accompanied by a companion named *Oxya velox*, these two being responsible for all the damage done.

Protection and Remedies.

It is not possible to prescribe with any certainty of success remedies for insects about whose life history so little is at present known, but where the operation is feasible, I would recommend that the young plants be dusted over a few times in the evenings with a mixture of quicklime and ashes. If the arsenic compound Paris green is available, a good mixture can be made with one ounce of the Paris-green, one ounce of unslaked lime and three pounds of ashes. Powder the substances together very finely, place them in a thin calico bag and dust over the plants.

Points in the life history requiring further observation.

1. When and where the eggs are laid.
2. The length of time the insect spends in the larval, *i.e.*, in the wingless condition. This is important since this and the egg stages are generally the easiest, in the case of locusts, to combat.
3. Length of time spent in the perfect or winged condition.
4. The number of generations passed through during the year.

OXYA VELOX,

BURM.

References :—Burm. Ent. 2. 6. p. 635. Acridium Hyla. Serv. Hist. Orthop. p. 678. Oxya Hyla. And.—Serv. Rev. pag. 96, no. 1. Gryllus velox. Fab. Ent. Syst. Tom. I p. 60.

Classification :—Order, **ORTHOPTERA**. Family, **Acridiidæ**.

Description.

Body shining. Head and prothorax apple green in colour; on the underside of the head behind each eye there is an oblique shining black stripe. Prothorax is pitted; the cross furrows very fine; no dorsal keel is present; on the sides touching the top there is a longitudinal black shining stripe in continuation of that on the head, which runs down on to the sides of the body. The elytra are a little longer than the body, rather narrow, rounded at their ends, transparent, with the inner edges opaque and green in colour; the outer edge is slightly dilated near the base. The under wings are as long as the elytra, transparent and colourless; the cross veins are very fine. Abdomen and tarsus greenish yellow; front legs and tarsus a light azure blue, the spines on the tibiæ being white, tipped with black. Antennæ yellowish, darkening towards the extremities. ♀. Length 1 to 1½ inches.

The male differs in length being ¾ to 1 inch long. Also the outer edges of the elytra have no pronounced dilation.

This species varies a great deal in length. The lateral black stripe is sometimes entirely or partially effaced. Pl. VI, fig. 2, shows this insect.

Life History.

Little has been recorded on the life history of this small locust. It is full grown in July-August, and has been reported as doing damage in many of the warmer parts of India during these months. Immature, *i.e.*, wingless specimens have also been reported from Ganjam, Madras, in November, and it may possibly turn out that these young ones result from the

eggs laid by the mature insects found in July-August. No data are available as to what becomes of these young insects during the cold weather months or as to when they mature.

In October 1893 fully mature specimens of this pest were very prevalent in the Peshawar District and neighbouring hills, proving that the life history in the colder parts of India will vary from that of the pest living in the warmer areas. It is probable that the insect will be found to have but one generation in the year in the former case, whereas two, if not more, may be the rule in the latter.

Localities from which reported.

This insect is generally found in company with *Tryxalis nasuta* in India, and is to be found all over the country in the areas given for that insect. In addition, it has been reported from the Khasi and Jaintia Hills, Assam, and the Peshawar District and neighbouring hills

Relations to the Forest.

Oxya velox was reported in company with T. *nasuta* as cutting down and feeding upon young blue pine (*Pinus excelsa*) and bamboo seedlings in sowings made in the Kangra Valley.

Protection and Remedies.

The same as given for *Tryxalis nasuta.*

Points in the life history requiring further observation.

1. When and where the eggs are laid.
2. The length of time spent in the wingless stage.
3. Length of time spent in the perfect or winged condition.
4. The number of generations passed through in the year—
   (*a*) in the warmer parts of the country.
   (*b*) in the colder do. do.
5. Where and how the insect passes through the winter and in which stage.

BRACHYTRUPES ACHŒTINUS.[1]

STOLL.

References :—Stoll. Gryll. pl. 2 c. fig. 8 ♂. fig. ♀.

Classification.—Order, **ORTHOPTERA.** Family, Gryllidæ.

VERNACULAR NAME.—*Thigi pŏka* (Chittagong Hill Tracts).

Description.

The following is a description of this large thick-set cricket: Body smoky brown, shining above; yellowish beneath. Prothorax longish and only slightly narrower behind, edged all round with a short dorsal furrow, and a faint cross line behind; it has two yellowish patches, longer in the female than in the male. Elytra brown above, the portions bent down on each side yellowish. Abdominal appendages ⅝ths of an inch long and yellowish. Tarsi yellowish; front tibia as long again as the tarsus; tibiæ of the hind legs furnished with two rows of strong spines, four on each side; the hair on the underside of the tarsal joint of front legs, as well as the fringe of its two claws, yellowish. Ovipositor of the female yellow, its valves brown on the outside. Antennæ brownish.

Length 2½ inches. Pl. I, fig. 1, a shows the larva and fig. 1, b the full-grown insect.

Life history.

The insects were first noticed towards the end of April, they being then about a quarter grown, see. Pl. I, fig. 1 a. About the end of May to the middle of June they are two-thirds grown, being then 1¾ inches in length. They live in burrows in the ground. These they construct in soft sandy situations, the tunnel starting at an angle to the surface level and running in a

---

[1] This insect was first reported to me by Ranger Ashutosh Chakravatty, in charge of one of the ranges in the Chittagong Division, Bengal. The notes on the life history are from observations made by the Ranger and myself, whilst the crickets were attacking a young rubber nursery in 1900.

zig-zag manner for some 2 feet and having a diameter of ½ to ¾ of an inch. At the end it is enlarged into a small chamber Holes examined were found to contain one, two, or as many as three larvæ. Up to the time the monsoon bursts the insect is a voracious feeder, gnawing off the leaves and top-shoots of young seedlings or cutting off the young plants at the level of the soil and dragging them away to its burrow to eat. It is a most wasteful feeder, as often, after biting through the stem of a young plant, it leaves it and proceeds to the one next to it, which is treated in the same way and then left to die, no part of it having been eaten by the insect. It is a nocturnal feeder and will only be found out of its burrow in the day time in very dull cloudy weather In the evening it sits at the mouth of its hole and may be recognized by its shrill piping. After the burst of the monsoon the insect apparently disappears for eight to ten weeks, as all injury ceased for this period and the holes were deserted. About September, however, when the rains are slackening, the insects again make their appearance and are then seen to be full grown, being about 2¼ to 2½ inches in length and having fully developed wings. They now begin again to feed voraciously, and in October may be found in the holes in pairs, a ♂ and ♀ living together in each burrow. These mature insects disappear at the beginning of November after probably laying their eggs in the ground near young vegetation.

Areas from which reported.

This insect was found attacking a young plantation at Kaptai in the Sitapahar Reserve in the Chittagong Hill Tracts.

The cricket has also been reported as very destructive in tea nurseries in the Jorhat District, Assam, and to jute and rice crops in Comilla, and is likely to have a wide range in the country.

Relations to the Forest.

The ravages of this insect in a nursery, if unchecked, are most serious. In addition to the large numbers of young plants it actually eats, when swarming in numbers, a very considerable quantity are wantonly bitten through by the pest and left

lying on the nursery beds or near the mouth of the burrows. I will be found that these latter are made all over the loose sandy soil of the specially prepared beds and will also occupy all sandy patches of soil in the neighbourhood of these beds, even as much as a hundred yards or more away. The presence of the insects can at once be recognized by the round openings of these burrows pitted all over the surface of the beds, and other favourable situations. Green portions of seedlings will often be found protruding from these openings, and the paths to them from the nursery, as well as the beds themselves, will be strewn with half-eaten fragments or whole seedlings dragged up from the soil or cut off at the ground level. This cricket is apparently omnivorous in its feeding but in the attack in the Kaptai nursery India-rubber (*Ficus elastica*) seedlings, with which the nursery was chiefly stocked, were its favourite food, young teak seedlings where found being also consumed.

Protection and Remedies.

In choosing sites for nursery operations, whether temporary or permanent, the area should be carefully inspected to see whether this insect is at work in the neighbourhood, and enquiries should be made as to whether its presence has been noticed.

When the insect has appeared in a nursery in numbers the crickets should be dug out of their holes and killed. Boys can be put on to this work at small expense, and satisfactory results will be obtained. For the ones which visit the nursery from outside, perfectly fresh young seedlings, poisoned by being dipped in a solution of the arsenical powder known as Paris green, should be scattered about the nursery after sunset and also near the holes and runs of the insect outside the nursery. This will get rid of a large number. In October, when the crickets are pairing, every hole should be carefully dug up and the pairs found in them killed.

In the Chittagong Hill Tracts this insect is esteemed a great delicacy by the Mugs, etc., who dig it up eagerly and roast and eat it with great relish.

Points in the life history requiring further observation—

1. Where the eggs are laid by the female and their number.
2. When the young crickets hatch out of the eggs.
3. What becomes of the nearly full grown larvæ between July and September.
4. Is there only one generation in the year.

SERICA ALCOCKI,

BRENSKE.

Reference :—Brenske in litt.

Classification :—Order, **COLEOPTERA**. Family, **Scarabaeidæ**. Sub-Family, **Melolonthini**.

Description.

A smallish thick brown beetle, black to plum-coloured above ; clypes rounded thickly but lightly punctured. Prothorax convex, rounded at sides. Scutellum small but broad. Elytra broadly striated, the striæ being irregularly punctured, the channels lightly punctured. Thighs broad, not spined ; hind tibiæ slightly dilated, front ones with two teeth. Antennæ slender, ten jointed, the club consisting of three small plates. The last joint of the maxillary palpus short, ovate, and pointed. Pl. IV, fig. 1, shows this insect.

Life History.

This beetle is found on the wing in the middle of June, and probably makes its first appearance somewhat earlier. The insect was discovered on the 16th June 1896 by Mr. C. G. Rogers, Deputy Conservator of Forests, feeding on *Mallotus philippinensis*. No further notes on its life history have since appeared, and where the larval and pupal stages are passed has yet to be discovered. As is usual with melolonthids, these will probably be passed in the ground, the larva feeding at night on young seedlings and spending the day in its burrow in the earth. It is thus probable that this pest will be found to do damage in both its larval and imago stages.

Area from which reported.

As far as my available information goes, this insect has only as yet been reported from the Dehra Dun District, North-West Provinces.

Relations to the Forest.

The beetle feeds on the young and tender succulent leaves of *Mallotus philippinensis*. Nearly the whole of the leaf, with

the exception of the midrib, is eaten. The pest apparently starts feeding indiscriminately either at the edge or in the middle of a leaf, but was not noticed to eat the old mature harder leaves.

The insect, like several other members of this sub-family, is said to drop to the ground the moment the leaf on which it is feeding is touched, and Mr. Rogers noticed that it was then, owing to its colouring, very difficult to see amongst the dead leaves and decaying vegetation.

Protection and Remedies.

In the nursery the Paris-green treatment should prove sufficient to stop this insect's attacks, since it is a foliage-eater in its adult stage. Other treatment will, however, be required for the larva should it make its appearance. The life history requires working out.

Points in the life history requiring further observation.

1. Where the eggs are laid.
2. When and where the larvæ hatch out and feed and the nature of their food.
3. The length of time passed in the pupal stage.
4. The number of generations in the year.

SINOXYLON CRASSUM,

LESNE.

Reference:—Lesne. Ann. Soc. Ent. de Belgique Tom. xli, p. 21 (1897)· *S. coptura*, Guérin (inédit).

Classification:—Order, **COLEOPTERA**. Family, **Bostrichidæ.**

Description.

Neither the *eggs* nor *larvæ* appear to have been yet described.

The *beetle* is oblong in shape, slightly dilated posteriorly, entirely brown in colour and rather shining. Antennæ and tarsi reddish brown. The elytra are strongly punctate and striated at their lower ends. Length 7—8½ millim. See Plate I, fig. 2, c. *S. crassum* is similar in appearance to *S. anale*, but larger and more robust in build.

Life History.

The beetles appear on the wing in April in the plains of the Punjab: in warmer parts of the country probably in March. They bore into felled timber and also into stag-headed and weakly trees for the purpose of egg-laying, the beetles tunnelling their way into logs either through the bark or through one of the cut ends. The gallery is gnawed straight down to the sap wood and the egg galleries then take off from it at an angle. Little indentations are cut in the sides of these secondary galleries and an egg laid in each. The larvæ on emerging feed on the wood, gnawing out short galleries in which they pupate. The beetles from these larvæ are those of the first generation of the year and come out of the wood towards the end of July. They at once attack fresh wood in which they lay eggs which give rise to the beetles of the second generation which appear in September-October.

Localities from which reported.

Specimens attacking Khair poles (*Acacia Catechu*) from the Raipur forests, obtained by Mr. F. Gleadow in July 1890,

were identified as *S. crassum.* The beetles were swarming in the poles. The insect has also been reported from Belgaum (in April) and Canara in the Bombay Presidency and also from Burma.

"Bostrichid beetles" were reported as damaging Sissu billets in the Changa Manga plantation, by Mr. B. O. Coventry in 1899: during April 1901 I found that *S. crassum* was one of the chief beetles engaged in this attack.[1]

Relations to the Forest.

S. crassum does serious damage to the fresh-cut billets and logs of Sissu (*Dalbergia Sissoo*) trees in the Shadhera and Changa Manga plantations in the Lahore Division. It also attacks stag-headed and sickly trees. When in numbers its galleries entirely riddle the sapwood and penetrate into the heartwood (see Pl. I, fig. 2, d). Stacks of wood so treated are covered on the outside with the yellowish wood-powder pushed out of the tunnels by the excavating beetles, and the wood has a dilapidated decaying appearance, its weight being at the same time greatly reduced. The commercial value of the wood is thereby lessened.

When stag-headed and sickly trees are badly infested their vitality is greatly reduced and they eventually succumb.

The beetles only attack felled timber while it is still fresh and sappy, but it appears to be immaterial whether bark is present or not. They also attack Khair (*Acacia Catechu*) wood in a similar manner.

Protection and Remedies.

The beetle's active life lasts from April to October, and during this period it attacks felled and stacked Sissu wood cut in the above mentioned plantations during the previous cold weather, November to March. This wood is stacked in heaps along the compartment lines in the forest and remains there till October, in order that it may dry and so become lighter. Owing to having this constant supply of fresh material always

[1] The beetles were kindly indentified for me by Mr. C. O. Waterhouse of the British Museum.

ready for it, *S. crassum* has increased in enormous numbers in the plantations and has now become a formidable pest.

The following are remedies I would suggest :—

1. Remove from the forest as soon as felled the amount of wood annually cut in the compartments, no fresh-cut wood being allowed to lie in the forest after the end of March.
2. That the fellings be so arranged that wood is not cut in advance of the selling power. The amount on hand at any one time being thus smaller, the number of breeding places for the insects will diminish.
3. The number of breeding places being thus reduced, measures will have to be put into force to deal with the large numbers of beetles which under these circumstances will attack the green standing trees.

(*a*) Careful watch to be kept for attacked standing trees. They will be recognised by small "shot holes" appearing in the bark with probably particles of sawdust at or near their entrances. Such trees, if badly infested, should be cut down at about the end of May (when they will contain larvæ and pupæ) and be chopped up and burnt. To ascertain the time to fell the tree, cut out a strip of bark and see if the bark and sapwood contain small white grubs or pupæ. If so, this is the time to remove the tree. If it is left longer the larvæ and pupæ will change into beetles and these will then bore their way out and leave the tree and attack fresh ones. This careful watch should be kept up between April and October for a year or two after the plan of immediately removing the cut fuel and logs has been adopted.

(*b*) To save green trees from being promiscuously attacked, "trap" trees could be used. Suitable trees are selected in convenient places adjacent to the areas in which fellings have just been made and are ringed or felled about February. The April beetles will

lay their eggs in these trees in preference to attacking green ones. The trees should be felled in May, cut up and burnt. In June another set of trees should be similarly prepared to catch the second generation of beetles, this second lot being cut down and burnt about the end of August.

Careful watching will show whether it is necessary to repeat this treatment the next year.

Points in the life history requiring further observation.

1. Where does the insect pass the winter, and in which stage, egg, larva, pupa or imago?
2. The number of generations passed through during the year. It will probably vary in different parts of India.
3. The number of eggs laid by the ♀ and method of laying them.
4. Description of larva and its method of feeding.

The Sissu billets examined were so terribly riddled by the beetles, etc., that my notes on the way in which the eggs are laidand the manner of feeding of the larval require corroboration.

SINOXYLON ANALE,

LESNE.

Reference.—Lesne. Ann. Soc. Ent. Belg. Tom. xli, p. 21 (1897). Stebbing Injur. Ins. Ind. For. p. 42.

Classification.—Order, **COLEOPTERA.** Family, **Bostrichidæ.**

Description.

The *larva* is a little white curved grub with the anterior segments enlarged and a median dark coloured line running down the back; three pairs of legs are present (Pl. I, fig. 2, a). The grub is active in its movements, wriggling about when disturbed. Length when full grown 4½ to 5 millim.

The *pupa* has the ordinary white beetle-like form which gradually assumes the shape of the mature insect (Pl. I, fig. 2,b).

The *beetle* resembles *S. crassum* in appearance but is smaller and of slighter build. It is at first light yellow in colour, becoming darker coloured as its outer parts harden. When mature it is oblong, slightly dilated behind, black, with the elytra anteriorly rufus-chestnut, more or less dusky, with antennæ, palpi and feet testaceous, the thighs being paler in colour and the abdomen reddish at the apex. The head has a toothed forehead. Antennæ end in a strongly fan-shaped club, the second joint of the club being about six times as broad as long. The elytra are strongly punctate posteriorly. Length 4 to 5½ millim. See Pl. I, fig. 2, c.

Life History.

The beetles appear early in April at Changa Manga, apparently at the same time as *S. crassum.* In Chota Nagpur they are to be found in March. They remain active, however, later in the year (as far as present observation goes) than the latter, as I have found them issuing from wood as late as the third week in November. The beetles attack trees and felled timber in a similar manner to *S. crassum*, and often these two pests are to be found at work together. The beetle bores its way into the sap wood and then eats out a largish chamber and from this two or

three secondary egg galleries take off. In small billets these may be found at all depths. The eggs are laid at the sides of these galleries, the female blocking up the notches in which they are laid and the gallery itself with sawdust. Larvæ were found in all stages of growth in the third week of April and pupæ between this and the end of the month. In May and June beetles have been reported as active, they being those of the first generation. Fully mature beetles also again appear in September, disappearing according to Mr. B. O. Coventry in October. The writer has found beetles issuing from Changa Manga Sissu billets in November. There would therefore seem to be a probability of there being three generations of this insect in the year. The pest probably hibernates through the winter in the larval stage or as a beetle, coming out and laying its eggs in fresh trees and cut wood in April.

Localities from which reported.

In 1897 I found this insect attacking sâl logs and sickly trees from March well on into June in Chota Nagpur. In October 1899 Bostrichid beetles were reported by Mr. B. O. Coventry from Changa Manga and in April 1901, I ascertained that one of them was *S. anale,* it occurring also plentifully at Shadhera.* The following further note on the distribution is given by Mr. P. Lesne:—

Bombay Presidency. Belgaum, taken at light in March, April, and also beneath old bark (Andrews); Canara, found in *Xylia dolabriformis*, Benth. and in Shisham(*Dalbergia latifolia*, Roxb.) (T. R. D. Bell); Burma (G. Q. Corbett). Mr. Bell has observed this species boring into the bark of the above mentioned trees and then mining out beneath the bark a longitudinal gallery; the female chooses dead trees, the wood of which is not quite dry. Mr. Bell has found the male and female in the same gallery in March.

Relations to the Forest.

The action of this pest in the forest is very similar to that of *S. crassum* described above. It is probably the greater pest of the two, since it will attack drier wood than its ally. Owing to this habit it remains burrowing into billets and timber for some time after they have been deserted by *S. crassum*

thereby greatly increasing the depreciation in the commercial value of the wood.

As we have seen Sâl, Sissu and Shisham (*D. Sissoo* and *latifolia*) and *Xylia dolabriformis* have up to date been reported as suffering from the attacks of this pest.

As in the case of its companion it appears to bore with equal ease into barked or unbarked timber, and this habit renders it all the more dangerous.

Protection and Remedies

The remarks made under this head for *S. crassum* apply equally here. In addition dead standing trees should be cleared out since the insect attacks wood in a dry condition.

Further, I would recommend that, if possible, the amount of fuel kept on hand in the fuel depôt at Changa Manga should be reduced to the least possible minimum if it is not possible to do away with the depôt altogether. In April I found *S. anale* riddling the wood in numbers of stacks and others, which had been in the depôt for some time, were very greatly reduced. Plate I, fig. 2, d, shows the results of the beetles' work in this wood.

Points in the life history requiring further observation.

1. The number of generations passed through during the year between March and November.
2. The number of eggs laid by the female and method of laying them.
3. In which stage or stages the insect passes the winter

[Some natural enemies of *Sinoxylon crassum* and *S. anale.*]

TERETRIOSOMA STEBBINGII,[1]

LEWIS.

Reference :—Lewis, Ann. Mag. N. Hist. Nov. 1901.

Classification :—Order **COLEOPTERA.** Family, **Histeridæ.**

Description.

Only the male *beetles* have yet been observed. The beetle is a small, compact, cylindrical, somewhat elongate insect, pitchy brown in colour, shining and rather densely punctured above. The head is not hidden by the prothorax ; antennæ are short and bent, with a compact club. The elytra are closely applied to the body but leave the last two segments exposed. Five ventral segments of the abdomen are visible. Length 2¾ millim. See Pl. I, fig. 5.

TERETRIOSOMA CRISTATUM,

LEWIS.

Reference :—Lewis, Ann. Mag. N. Hist. Nov. 1901.

Classification :—Order, **COLEOPTERA.** Family, **Histeridæ.**

Description.

Only the male *beetle* of this insect is known.

This beetle is very similar to the one above described. It is piceous in colour, the thorax being more convex than the dorsal region, and the scape of the antennæ bearing long, palish hairs. The insect greatly resembles the one shown in Pl. I, fig. 5.

[1] This and the following beetles were kindly named for me by Mr. Lewis, F.L.S., to whom my thanks are due. The first two proved new to science.

TERETRIOSOMA INTRUSUM,

MARSEUL.

The characters of this *beetle* are very similar to the above mentioned two species, and for the purpose of these notes the insect will be sufficiently recognised from the above descriptions and figure.

Life history.

The above three species of *Teretriosoma* are predaceous insects and were found together in numbers in the galleries bored by the *Sinoxylon* beetles, and more especially amongst their larvæ on which they feed. It has yet to be observed whether they also attack and devour the *Sinoxylon* beetles in their mature state. These useful insects are at present only known in their imago stage, their larval forms and the manner in which they feed being as yet undiscovered.

Areas from which reported.

All the three species were found by the writer in the galleries made by the *Sinoxylon* beetles in the Shahdera and Changa Manga Plantations of the Lahore division in the Punjab.

Relations to the Forest.

Owing to their predaceous habits these insects are of the greatest importance in the forest, as their operations tend to keep down the numbers of two bad timber-boring beetles.

Protection.

As these beetles are found in the same positions as the *Sinoxylon* beetles, my recommendations for exterminating these latter will result in destroying large numbers of their predaceous enemies. It is evident, however, that at Changa Manga exceptionally favourable conditions have resulted in such an enormous increase of the boring beetles that their *Teretriosoma* enemies are no longer able to cope with the numbers and keep them in check, as, under normal conditions, they would probably be able to do. It has become necessary therefore for the forester to step in and my recommendations for the necessary treatment have already been described.

BOTHRIDES SP.

Reference :—Provisionally named as *Bothrides* sp. by Mr. C. O. Waterhouse of the British Museum, to which collection the insect is new.

Classification :—Order, **COLEOPTERA**. Family, **Colydiidæ.**

The *beetle* is narrow, elongate, parallel, shining, and light brown in colour above and below. The head is largish and protrudes beyond the prothorax ; eyes round and fairly prominent ; antennæ end in a terminal club. Prothorax a little separated from elytra, squarish ; head and prothorax strongly punctate above. Elytra deeply ridged longitudinally and punctate between the striæ. Legs light brown ; tarsi 4-jointed, none of joints being broad ; hind coxæ are separated, fore and middle ones close to one another ; five visible ventral segments. Slender, active insects ; very quick in their movements. (Pl. I, fig. 6).

Life history.

The beetles, which are predaceous, were found in the same places as the *Teretriosomas* above described, and were more especially abundant in the galleries containing numerous *S. anale* larvæ ; it is not improbable that their attacks are confined to these latter, and perhaps to their pupæ.

The notes given under "area from which reported," "relations to forest" and "protection" for the *Teretriosomas* apply equally here.

Points in the life histories requiring further observation :—

1. Female insects of the *Teretriosomas* have yet to be discovered.
2. The larvæ of all these predaceous beetles are yet unknown.
3. We require to know when the eggs are laid and where, and on what the larvæ feed.
4. The pupal stages are still unknown.
5. The number of generations in the year, and whether these correspond in number with those of the insects they live upon.
6. Whether they prey upon the imago stages of the *Sinoxylon* as well as the larval ones.
7. How and where they pass the winter.

MIMASTRA CYANURA.

HOPE.

Classification :—Order, COLEOPTERA. Family, CHRYSOMELIDÆ. Sub-family, Galerucidæ.

Description.

This small beetle is yellow in colour, shining, with filiform antennæ about ¾ the length of the body. The head is small, round and separate from the prothorax. Prothorax quadrangular, slightly longer than broad. Elytra oblong-oval, dilated behind and very obtuse. Legs longish.

Life History.

The beetle appears on the wing about the middle of June or perhaps earlier, it having been found by Mr. C. G. Rogers, Deputy Conservator of Forests, defoliating trees on the 18th of the month. Neither larva nor pupa appear to have been noted, and no further observations on its life history are forthcoming with reference to the dates of appearance of these stages and the number of generations in the year.

Locality from which reported.

This beetle was found in the Dehra Dun District in 1896.

Relations to the Forest.

M. cyanura is a leaf-feeding chrysomelid, and defoliates both young and old trees of the species *Grewia asiatica.* In the attack noticed in 1896 the beetles were said to have appeared in large numbers flying freely and being sufficiently numerous to produce a humming noise as of a swarm of bees passing overhead. The majority of the leaves were badly eaten by the 18th June, in many cases only a short piece of the base of the midrib remaining intact. No birds were present feeding upon these beetles, and it is probable, as noted by Mr. Rogers, that the thick orange liquid which they have the power of emitting from their heads has some distasteful quality in its composition.

Protection and Remedies.

These leaf-feeding beetles are best attacked by one of the arsenical solutions, preferably Paris-green, sprayed on over the plants to be protected, and this spraying should be done either in the very early morning or late in the evening. The beetles feeding upon the leaves take the poison internally, and are thus killed off.

More facts about the life history, such as where the eggs are laid, where the larvæ feed, etc., are required to be known before one can state definitely how such pests can be best attacked.

1 - FEB 1905

XYLOTRECHUS VICINUS,

L and G.

References:—L. and G. Mon. p. 38. Decan. Clytus vicinus, Lacord. Ins. IX. 1, 78.

Classification:—Order, **COLEOPTERA**. Family, CERAMBYCIDÆ.

Description.

Beetle. Head not very large, rounded between the antennæ, convex slightly in front, with short cheeks. Antennæ do not reach to the middle of the elytra, are thin and filiform. Eyes large. Prothorax ovate tapering towards the head. Elytra slightly convex, not meeting at posterior edges, thus leaving a portion of the abdomen exposed. Legs long and not very thick; the femora slightly thickened and those of the hind legs reaching beyond the elytra. In the females the antennæ are a little shorter and the femora of hind legs only reach to the elytra tips. See Pl. IV, fig. 2.

Life History, etc.

Little is known on the life history of this insect. The larva tunnels into the wood of the Oak (*Quercus dilatata*), and specimens of the mature beetle were discovered in the trees in August last and sent to me by the Ranger in charge of the Kilba Range, in the Bashahr State, Punjab.

The insect is of interest, since it is closely related to the well-known coffee tree borer of South India, *Xylotrechus quadripes*,[1] Chur.

Observations are required as to how long the larva of *X. vicinus* spends feeding in the tree, the length of time passed in the pupal stage, where the eggs are laid, etc.

---

1 *Vide* Injur. Ins. Ind. For. p. 80-81.

APRIONA GERMARI,[1]

HOPE.

Classification:—Order, COLEOPTERA. Family, Cerambycidæ. Sub-Family, Lamiidæ.

Description.

The *larva* is a long, white, thick, grub with a well developed head, powerful mandibles, and large thoracic segments. It is legless, and when fully developed is about 3 inches in length and ½ an inch across the thoracic segments.

The mature *beetle* is 1½ inches in length and is covered all over with a golden brown pubescence. Its elytra are rough and scarped at their anterior surfaces, where they are dotted with small black raised points. Colour is more golden on the under surface. Legs same colour as elytra, tarsus slightly darker. Specimens with this colouring were found in 1897. In 1898, one beetle taken resembled in form the above, but differed in colouration. The colour was a dirty yellow, but the elytra had several white blotches on them and there were two bright orange spots on the thorax. It differed also on the underside in having a broad white marginal band round the abdomen extending to the head, thus being unlike the uniform colouring of the other specimens. The first described specimens were identified for me by Mr. C. O. Waterhouse, of the British Museum, as *A. Germari.* I have not seen the 1898 beetle. The difference in markings *may* be due to a difference in sex only. Pl. IV, fig. 3, shows the larva, pupa and imago.

Life History.

The larva of this beetle has been found infesting stems of the mulberry (*Morus indica*). Its presence has been known for

---

[1] The notes on this beetle have been drawn up from careful observations made by Mr. B. O. Coventry when in charge of the plantation it infests, from observations made by the writer when visiting the plantation, and from the correspondence on the subject by Messrs. C. G. Rogers and B. O. Coventry, published in the *Indian Forester*, Vol. XXIV, pp. 203, 204 and 341—345; Vol. XXV, pp. 68, 69.

some years (Mr. Rogers mentions finding it in 1892), but neither the pupæ nor beetles were known at the Shahdera Plantation, where it is reported from, till specimens of both were discovered by Mr. B. O. Coventry in 1897.

Larvæ of all sizes can be found in the stems at all times of the year, this clearly denoting that they take a year or more to mature. Both pupæ and beetles were found in the middle of July, but none of the latter are said to be discoverable in the stems in August. It is thus probable that the beetle's flight time is at the commencement of the rainy season. As the perfect insect is not to be found later on in the year, it probably at once pairs and lays eggs on the bark of the stems which, being now full of sap and soft, will be easily bored into by the young still tender mandibles of the small larvæ. The young grubs remain for a time boring in the sapwood and then as they get stronger go into the heartwood and tunnel up and down this. Some tunnels I inspected were 7 to 8 feet and more in length. As soon as the tunnel enters the sapwood, branch tunnels to the outer surface of the bark are gnawed out at intervals for aeration purposes, and the course and direction of the tunnel within the stem can be traced by these holes on the outside, the holes becoming larger and larger since, as the larva grows in size, it necessarily bores a tunnel of larger diameter and the offsets to the outside also increase in circumference. Careful search has failed to show that more than one larva is ever present in any one stem, and therefore it must be considered probable that the beetle lays but one egg on any one tree. The position on the stem where it is laid would appear to vary as Mr. Coventry considers it to be always high up, whereas my own observations on some cut stems showed that in these cases the larva had commenced its tunnel in the sapwood at the foot of the tree. Mr. Coventry wrote :—

> The larvæ, commencing high up, burrow down the entire length of the stem, and often a considerable way down one of the main roots . . . . After reaching its lowest limit the larva appears to hollow out a chamber sufficient to enable it to turn round, and then burrows straight up the stem again, sometimes following the old gallery and sometimes striking a new one.

It is not improbable that the chamber here referred to is

made to enable the grub to rest for a period during the coldest part of the winter, but this opinion requires corroboration. By far the longest part of the tunnel, including all the portion with a large diameter, is to be found in the heartwood, the larva seeking this and leaving the sapwood as soon as its mandibles are strong enough to enable it to bore into the former.

Locality from which reported.

Although the larvæ and its work had been known for some years at the Shahdera reserve, a Sailaba plantation on the banks of the Ravi about 5 miles from Lahore, Punjab, it was not until 1897, that beetles were obtained by Mr. B. O. Coventry from which the insect was identified as *Apriona Germari.*

Relations to the Forest.

Mulberry stems are very badly infested by this beetle which confines itself to this tree and does not attack its companion the Sissu. The eggs are most usually laid on the main stems of young living coppice shoots, about three to four years old, and 2½ to 3″ in diameter, and the insect grows in size with the development of the tree. Attacked trees can be recognized owing to a rusty red stain running below each air-hole made by the larva, the stain being caused by the trickling down of sap from these holes; also very often by the presence of saw-dust at the foot and on the bark of the tree. The attacks of the larva do not kill the tree, but the galleries bored up and down the stem ruin the wood for timber purposes, and at Shahdera the mulberry is only sold as firewood. A large proportion of the young trees are infested, and the old ones mostly bear the marks of previous attacks in the unsightly wounds, often of large size, which are to be seen on their stems. These wounds have originated from the air-holes of the larva and the large exit hole made by the beetle. Decay sets in at these points, and is probably accelerated by rain water. These large wounds are not to be found on trees containing living larvæ.

Protection and Remedies.

Mr. Coventry has suggested that the only practical remedy is to cut out all attacked stems and collect and destroy the larvæ. The damage chiefly originates in the young com-

partments, and the removal of attacked stems would be in the nature of a light thinning which would be beneficial rather than detrimental to the growing stock. This opinion entirely agrees with my own, and, being that of an officer who has held charge of the plantation, is, I conclude, a feasible one. We have already seen that the stems containing larvæ are easily recognised: each stem cut down should be carefully cut up, including the roots if necessary, until the larva is found and destroyed before a fresh one is felled. This work would require the most careful supervision, as upon its being done thoroughly would depend the stamping out of the beetle completely. The larvæ found should be made to tally with the stems cut. If this plan were resorted to and a careful watch kept, I see no reason why the pest should not be exterminated. A strong reason for endeavouring to free Shahdera entirely from this beetle exists in the fact that it has not made its appearance in the Changa Manga Plantation only 40 miles away. Careful search during several years has failed to bring to light a single case of attack on the mulberry at the latter place, and the wood of the tree can thus to a certain extent be sold as timber. The danger of the beetle spreading to Changa Manga is very great, and increases yearly as the pest becomes more numerous at Shahdera. That it has not done so already is probably attributable to one of two causes: either the beetle lays very few eggs or it is heavily parasitised. That it will spread across such a short strip of country if given the time to do so is only too probable.

One further suggestion may be made here. When commencing a search for *A. Germari* at Change Manga I discovered that only one forest guard, out of the whole staff of officers in charge there, had ever seen the work of the longicorn at Shahdera, or knew what its appearance was like or what to look for in the search I was about to institute. I explained with drawings at the time the appearance of larva and beetle and its work in the tree, but if it be feasible I would recommend that the entire staff at Changa Manga should be deputed as occasion offered to visit the Shahdera plantation and there be shown the insect at work. They would thus be in a position to recognise it should it unfortunately get to Changa Manga,

and early steps could be taken to stamp it out before it spread.

Points in the life history requiring further observation.

1. The height on the bark of the stems at which the eggs are laid.
2. The number of eggs laid by the beetle.
3. The exact number of years passed in the larval stage.
4. The number of days passed in the pupal stage.
5. Whether the differences in colouration of the beetles found is merely a sexual one, the species being the same.

LIMNOBIIDÆ.

Reference:—The larvæ in question were provisionally identified as Limnobiids by Mr. C. O. Waterhouse of the British Museum.

Classification:—Order, **DIPTERA.** Family, **Limnobiidæ.**

In the tunnels bored by the longicorn larvæ *Aprioua Germari*, in the mulberry stems at Shahdera Plantation, I discovered in the oozing sap some thin, semi-transparent, white larvæ, from half an inch to one inch in length. The larvæ were crawling about in the sap in the tunnels and are not improbably sap-feeders and not parasitic on the longicorns.

No further data about the life history of this insect are at present available.

---

1 FEB 1903

MYLLOCERUS SP.

Classification :—Order, COLEOPTERA. Family, Curculionidæ.

This insect was found in company with *Apoderus sp.* defoliating the leaves of the Sissu trees in the Sutlej valley.

Description.

The beetle is a brightish grey-pink in colour, about half an inch in length. Dorsal surface grey-pink with black hieroglyphic markings on the elytra, which are slightly channelled and pitted. Under surface grey. Antennæ and legs grey. Pl. III, fig. 2, shows a dorsal and side view.

Life History.

This beetle is found on the wing in the middle of June when it defoliates the Sissu, feeding on the leaves of the tree. I was not noticed pairing, and I was not able to form an opinion as to whether it had done so or not. The specimens found seemed to be chiefly intent on feeding.

The Writer is not at present able to say whether further observations have been made on the life history of this insect.

Locality from which the insect has been reported.

I discovered this beetle in the Sutlej valley at elevations of between 2,300 and 3,500 feet. It was found on both banks both in the Kulu and Bashahr States.

Relations to the Forest.

This beetle feeds on the leaves of the Sissu tree. It was not very abundant at the time it was observed, but the damage to the leaves was very appreciable. It appears to prefer the older leaves, as it was on them that it was generally to be found, but this may have been attributable to the fact that most of the new ones had already disappeared under the attacks of the *Apoderus* leaf-rolling beetle. The beetles eat into the leaf, gnawing out portions and beginning from the

outside edge. The portions eaten out are either circular or irregular in shape, and sometimes the midrib is reached, but this was rarely touched by the insect. The leaf was more often eaten irregularly away on both sides of the midrib, leaving the latter intact.

As this beetle affects the old leaves as well as probably the new, it is capable of doing serious defoliating injury to the trees when swarming in numbers.

Points in the life history requiring further observation.

1. Where the eggs are laid and their number.
2. Where the larva passes its existence, the nature of its food, and time spent in the larval stage.
3. Length of time spent in the pupal stage.
4. Number of generations passed through in the year.

APODERUS SP.

Reference :—Provisionally named as *Apoderous* Sp.

Classification :—Order, **COLEOPTERA.** Family, **Ourculionidæ.**

Description.

The eggs are pale yellow in colour with a glistening surface, and about the size of a large pin's head. I have not yet seen the larva. It will probably be a small, whitish, curved, legless grub.

The female beetle is similar in colouring to the male but is larger, being about a quarter of an inch in length, while the male is one-sixth of an inch. The general colour throughout the insect is a bright golden yellow. Head, thorax, and elytra are edged with black except at the outer upper edges of the elytra where they are golden yellow. Snout and eyes are black. Antennæ yellow at the base and furnished with black knobbed ends. Forehead between the eyes black. Elytra channelled and they have three black patches in the form of a triangle on their upper halves, the patch at the apex being at the anterior end : the elytra are edged with black on their inner margins and the anterior outer corner of each bears a light brown spot ; they do not completely join at their bases, leaving several body segments exposed. Under surface of the prothorax between the coxæ a darker yellow-brown. Legs bright golden yellow. Pl. III, fig. 1 *a*, shows dorsal and side views of the ♀ beetle, and *b*, dorsal view of the ♂.

Life history.

The beetle appears on the wing in June. From the 18th to 20th of the month I found it in abundance actively engaged in laying its eggs. In a few cases the beetles were seen to be pairing, but this stage was evidently nearly over, as was evidenced by the fact that a large number of eggs had been already laid. My observations showed me that never more than one egg is laid on any one leaf. The mother beetle

proceeds about her egg-laying in the following manner. Usually the egg is deposited to the left hand of the midrib near the apex of the leaf. The leaf is then folded along the midrib, the surfaces on either side being turned inwards. The beetle then rolls the leaf tightly up from the apex downwards, tucking in the outer edges, so that the ends on either side are symmetrical and the whole forms a tight little roll. The end of the stalk where it expands into the blade of the leaf is then partially cut through, so that the little rolled-up mass hangs downwards. In other cases the beetle cuts the leaf at a point about one-eighth or at most one-sixth of the length of the leaf above its juncture with the leaf stalk. This is done in two ways: either the leaf is cut through right across by a horizontal incision, only a small portion of the outer edge being left to support the cut portion or the beetle cuts through the leaf horizontally on either side of the midrib, starting on each side from the outer edge of the leaf and cutting inwards to the midrib which is only slightly notched. In each case the egg is laid in the same place and the leaf rolled up as above described. These little bundles containing each an egg hang down (see pl. III, fig. 1, *c*), suspended by the portion of midrib still uncut or by the small portion of the outer edge of the leaf still intact, as the case may be; this small uncut portion soon dries up and the little rolls then fall or get knocked off and drop to the ground. (fig. 1, *d*). I have not yet been able to ascertain how many eggs are laid by each beetle, but it is almost certain that more than one is laid, *i.e.*, that several leaves are so treated by the beetles. From the eggs a small grub will emerge which probably at first feeds upon the store of food thus provided by the mother beetle, subsequently penetrating into the soil and changing into the pupal state. This is what happens in the case of the English leaf-rolling species *Rhynchites betulæ* which rolls up birch leaves into a funnel-shaped structure in which several eggs are laid.

This beetle resembles, in the performance of this marvellous piece of work, a closely related Indian confrère which treats the leaves of the Ban (*Quercus incana*) and Moru (*Quercus dilatata*) oaks in a somewhat similar fashion.

Locality from which the insect has been reported.

The writer obtained this beetle in June 1901 on the banks of the Sutlej river, where it flows between the Kulu and Bashahr States, at elevations of between 2,500 and 3,500 feet.

Relations to the Forest.

Whilst marching up the Sutlej Valley between Nirth and Rampur the writer noticed that the sissu trees on either bank of the river were being heavily defoliated. The trees were growing either in clumps or scattered here and there in the river bed and on the terraces existing on either side of the stream. An examination showed that the defoliation was not due to any ordinary leaf-feeding insect. A certain amount attributable to the latter cause was certainly going on, but the serious part of the work was due to quite a different form of attack. The first thing that attracted notice was the fact that the crowns and ends of all the branches of the trees, consisting of long yellowish green shoots just developed, or in the course of development, were either totally leafless or rapidly becoming so. The effect to the eye was as if one had taken the new leaf-bearing twigs into the hand and pulled them through the closed palm so as to remove the new leaves, leaving behind only the long, bare, whippy, yellow-green new shoots. A closer inspection, however, showed that these shoots were not entirely bare. In many cases small portions of a leaf, looking as if they had been snipped off either just above the juncture of the stalk with the leaf or at the stalk itself, were visible and often hanging down from these a small bundle of rolled-up leaf. These latter enabled me to perceive what was taking place. A leaf-rolling insect was at work and in each of these bundles, as already described, an egg had been placed by the mother beetle, and in so laying their eggs the beetles were stripping the sissu trees of the entire crop of their new leaves. In some cases the little bundles had dropped, in others they had turned black and were ready to do so, whilst others again were still green and fresh, and I was able myself to see others in the course of formation. Every tree on the 16 miles of river I inspected, both on the Bashahr and Kulu sides of the

stream, was either entirely defoliated of all its new growth or rapidly becoming so, and there seems no reason for supposing that the attack did not spread some distance further, both up and down stream. The fact that the insect either rolls up the whole of the leaf or cuts it across very close to its base renders the destruction of all leaves attacked complete.

In addition to attacking the whole of the crop of new leaves I noted that the beetle also laid its eggs on and rolled up the older leaves as well though in nothing like the same proportion. It was probably the abundance of the beetles and the shortness of the supply of the new leaves that sent the insects to the old ones, as these must have been infinitely more difficult to bend over and roll up than the soft tender young ones.

Protection and Remedies.

In the present state of our knowledge of economic entomology in this country it is not possible to consider remedies for application over large areas. The beetle probably has both fungus and insect enemies, and the larva likewise, the encouraging or introduction of which would keep it down. In nurseries and small valuable plantations the question is not so difficult. In such places I should advise the sweeping up into heaps of the small fallen leaf rolls, each of which, it must be remembered, contains an egg and therefore a future beetle, and burning them *in situ*. This work will be very simple if carried out when the beetle is just finishing its egg-laying as the ground then will be littered with the small rolls and by jarring the young plants numbers will at once drop. In the case of small areas the ground could be gone over two or three times to make sure of removing and killing off as many eggs as possible. Over larger ones one round would have to be sufficient, and it would be important to choose the right time, so that the maximum number of eggs possible may be destroyed. When the defoliation is about three-fourths complete would be the best time to go round large areas. If the work is delayed longer, the larvæ from the first laid eggs will have left what remains of the small rolls and have gone into the ground, and it will then be too late to take steps against them unless

ploughing or hoeing were resorted to, both of which would probably be out of the question as involving too large an outlay.

Points in the life history requiring further observation.

1. The number of eggs laid by the beetle which will show the number of leaves each destroys.
2. Time spent by the larvæ in the rolled-up leaf before leaving it.
3. Ascertain definitely whether the larva enters the ground to pupate.
4. Length of time passed in the pupal stage. It is not improbable that some 10 months or more will be passed in this stage.
5. Whether there is more than one generation during the year.

ALCIDES SP.

Reference:—Provisionally determined by Mr. C. O. Waterhouse, of the British Museum, as a species of Alcides not in the Museum.

Classification:—Order, **COLEOPTERA**. Family, **Curculionidæ.**

Description.

The *larva* when full grown is a fat white grub usually more or less curled with twelve segments, the middle ones thicker than those at either end. Head small and bright yellow-brown in colour. Length ¾ inch. See Pl. IV, fig. 6, *a*.

The *pupa* is of the ordinary curculionid shape.

The *beetle* is black in colour with black antennæ and legs the latter clothed with yellowish-brown hairs. The rostrum (beak) is straight, thickish, about half as long as the insect, the grooves (scrobes) in it on either side starting about one-third down from the tip. Antennæ medium sized, fairly thick; the scape is thickened at the joint and the funiculus ends in a thick oval knob. Eyes large and elliptical in shape. Prothorax rather triangular drawn out in front and produced into a small point behind at its junction with the inner angles of the elytra. Elytra meeting well together and rounded at bases. Prothorax and elytra studded with raised points. Body pubescent. Front legs longer than the others. Pl. IV, fig. 6, *b*, shows a dorsal and side view of this beetle.

Life History.

The beetle appears on the wing at about the beginning of August, but at present it is not known when or where it lays its eggs. Larvæ were found full fed in walnuts in the first week in July, and it is therefore probable either (1) that the weevil is to be found on the wing throughout the autumn, hibernating under bark or decaying leaves, stones, etc., on the ground and coming out to lay its egg on or near the young ♀ flowers of the walnut in March or April; or (2) it lays its eggs on the twigs near the young flower buds in the autumn of the year in which it issues as a beetle. No external holes are to

be found on the green outer covering of the walnut. I first noticed the attack in the Baghi forest, Bashahr Division, my attention being attracted by the number of fallen walnuts littering the path beneath a large tree. I cut open some of these nuts and found in them the nearly mature fat, curved grubs of this weevil. A large number of nuts were examined, and four to five grubs per nut appeared to be the usual number present, but in many cases 8, 11, and in one or two as many as 13 larvæ were cut out of a single walnut. The attacks of these grubs cause the fruit to wither, and about the first week in July the nuts drop from the tree and the larvæ enter the earth and pupate there about the middle of the month. Fifteen to twenty days suffice for this stage, the first beetle obtained issuing on the 4th August.

Locality from where reported.

This weevil was discovered in the forests between Taklesh, Bahli, Songra, and Baghi, Bashahr State, North-Western Himalayas in 1901.[1]

Relations to the Forest.

Many of the walnut trees examined between the above-mentioned places had their entire crops of seed ruined by the attacks of the larvæ of this curculionid. The effect of these operations within the nut is to reduce the inside to a black rotten mass of tissue and excrement in which the grubs live. The whole of the kernel and inner hard shell (endocarp) is reduced to this state, and only the hard outer green covering (pericarp) with a very thin layer of the inner shell is left intact. No holes of any kind are to be seen on the outside of this green outer covering. By the time the inside of the nut is brought into this condition it falls to the ground into which its weight, which is still considerable, causes it to sink. The period of this dropping of the nuts is also that at which the monsoon usually bursts over the hills and the grubs consequently have no difficulty in entering the softened ground.

[1] I placed the nuts I collected in a box containing a layer of moist earth. On leaving Simla on July 17th, Mr. J. H. Lace, at the time Assistant Inspector General of Forests, kindly undertook to look after them for me and he obtained these beetles.

Points in the life history requiring further observation.

1. Where and when the eggs are laid—a very important point in connection with attacks of this kind.
2. The length of time spent in the adult stage. Also a very important point.
3. Where, and in which stage, does this insect pass through the winter.

CRYPTORHYNCHUS SP.

Reference:—Provisionally determined as *Cryptorhynchus* sp. by Mr. C. O. Waterhouse, of the British Museum. Mr. Waterhouse wrote that it was at present impossible to name the species, it being new to the Museum.

Classification:—Order, COLEOPTERA. Family, CURCULIONIDÆ.

Description.

The *larva* is a small white, thickish, legless, curved grub of the ordinary weevil type. Length nearly ⅜in. See Pl. IV, fig. 7, *a*.

The *pupa* is naked, dark in colour and tucked round it the developing wings can be distinctly seen. On the underside the legs and the proboscis, both still immature, are to be seen folded on the breast and body.

The *beetle* has the ordinary weevil shape. Head and rostrum black, the latter a little more than a ¼ length of insect, not very thick and tapering slightly to apex ; it is tucked under body at rest: the scrobes (grooves in which the scapes of the antennæ fit) commence a little above the middle of the rostrum and are slightly oblique, directed upwards to the point where the base of the antennæ takes off. Antennæ fairly stout, the scape swollen into a knob at the point of its juncture with the funiculus (upper part of antenna, above elbow) ; funiculus ends in an oblong oval knob. Eyes large, strongly facetted. Prothorax triangular tapering anteriorly, black marked with brownish spots. Elytra reddish-brown meeting well together ; channelled with a small white blotch about their centre and a larger one towards posterior extremity of each. Legs smallish, thighs gradually thicken to a lump where the tibiæ join them, the posterior ones not reaching to the end of the abdomen. Tarsi long and hairy beneath.

Pl. IV, fig. 7, *b*, shows the pupa and, *c*, the mature beetle.

Life History.[1]

The flight time of this weevil is about the beginning of December at which time all the stages of larva, pupa, and adult beetle may be found beneath the bark of the host plant.

The larvæ were found just beneath the bark of young *Pinus Khasya* trees. They apparently feed on the cambium layer and grow to full size here and then gnaw out a cavity in the wood, line it with wood chips, and change into the pupal state within this little cell. These cavities were invariably found to be packed with fresh moist wood chips or 'wood wool' when they contained larvæ, whereas in those containing mature or nearly mature adult beetles the wood wool was found to be dry and yellow. When the weevil is ready to issue, it bores a fresh hole straight through the bark of the sapling and crawls out.

This is all that is at present known about the life history of this pest. Observations on the subject for the other eleven and a half months of the year are required.

Locality from which reported.

This beetle was reported in December 1901 from a plantation in Maymyo, Upper Burma.

Relations to the Forest.

The attacks of this weevil were pointed out to Mr. Long, whilst inspecting an experimental plantation of *Pinus Khasya* by Mr. D. A. Allan, Ranger. Numerous trees, five years old, were seen to be dying. In some cases these trees were suppressed by their neighbours, in others the dominant trees themselves were dying. On felling and examining one of the latter, the various stages of the beetle were found in abundance. Most of the larvæ were already full fed and had left the bark and were ensconced in cavities in the wood of the saplings, these cells having been generally bored within a foot of the ground and never, as far as was observed, more than two feet above the surface of the soil.

[1] The notes here given on the life history of this pest, together with larva, pupa and adult beetle, were forwarded to me in December 1901 by Mr. G. R. Long, Personal Assistant to the Conservator of Forests, Southern Circle, Upper Burma.

The tissue surrounding recent cavities was fresh and sound; that round old ones spongy and rotten. In most cases Mr. Long noted that "the woody tissues, often to the centre of the tree, were stained blue as though by fungoid mycelia, and I incline to think that, although the insects do damage, it is the fungus which they let in that proves fatal."

"The plantation is about 3,200 feet above sea-level, and has a southern aspect. Other *Pinus Khasya* trees, scarcely 200 yards away, having a northern aspect, having so far escaped attack. *Pinus longifolia* also with a northern aspect has not yet been attacked."

This question of the aspect may or may not have any connection with the prevalence of the attack, but these wood-boring pests usually spread slowly: when, however, they appear at a centre in numbers, they spread outwards from this area, and if their attack is unchecked and conditions are favourable, their numbers increase very rapidly, and following this increase the infertation radiates rapidly in all directions from the original source.

Protection and Remedies.

Where feasible, undoubtedly the best remedy in cases of attacks of this nature is to cut out all infected stems and burn them at once. If this operation is carried out carefully, it will effectually stamp out the trouble. This is the remedy I suggested in the case in question, but as many of the weevils would have already issued, a careful search should be made for eggs and a watch kept for the signs of fresh young larvæ appearing in the trees.

With reference to the blue stain in the bark, attributed by Mr. Long to the mycelia of a fungus which he considers may be the final resulting cause of the death of the tree, it must be borne in mind that since it commences at the holes made by the weevils, their attacks would seem to be the primary cause of its presence in the trees. I have not as yet seen any of the attacked stems with this fungus *in situ*, so am unable to express any opinion on the subject.

Points in the life history requiring further observation.

1. Where the eggs are laid. It is not improbable that the weevil makes small incisions in the bark with its proboscis and places its eggs in these.
2. The time spent by the larvæ feeding in the bark of the tree before it gnaws out its pupating chamber in the wood.
3. The life history of the insect from January to November. How many generations in the year does it pass through and the length of time spent by the various stages of egg, larva, pupa and beetle, should there be more than one generation in the year.

WOOD-BORING LEPIDOPTEROUS LARVÆ.

Accompanying the weevil larvæ found in the bark of the *Pinus Khasya* trees as above described, a number of other and larger larvæ were sent to me mixed up with the weevil grubs.

These larger larvæ are pink in colour with three pairs of jointed legs on the first three segments of the body, four pairs of sucker legs, one on each of the sixth, seventh, eighth, and ninth segments and another pair on the anal segment. The presence of these determines the larva to be a lepidopterous one, and it probably belongs to one of the wood-boring families of the *Heterocera* or moths. These larvæ require further careful study as they may prove to do as much, if not more, damage than the weevils. They were only found in the bark and were not full-grown. It will perhaps turn out that as they grow older they will leave the bark and bore into the wood. See. Pl. IV, fig. 8.

I have recommended that some of the stems attacked by these larvæ be kept under supervision with the object of obtaining the pupæ and moths of the pest for identification. All other stems infested with the grubs should be cut out and burnt so as to stamp out the pest before the moths mature and issue from the trees to lay eggs and spread the attack to uninfested ones.

SCOLYTUS SP.[1]

Reference:—Provisionally determined as *Scolytus sp.* near *Scolytus destructor.*

Classification:—Order, **COLEOPTERA.** Family, **Scolytidæ.**

Description.

The *larva* is a small, white, curved, legless grub, about 5·1 millim in length. See Pl. IV, fig. 4, *a.*

The beetle is black and shining, cylindrical, antennæ and legs being fulvous brown with yellowish-brown tarsus. Head projecting with a broad rostrum. Under surface of abdomen is flexed upwards. Thorax longer than broad, sparingly punctured, the punctures being smaller and weaker on upper surface, which is very shining. Elytra uniformly pitted over with punctures, suture of elytra depressed. Length 5·5 to 6 millim. Pl. IV, fig. 4, *b,* shows a dorsal and side view of this insect.

Life History.

This beetle appears about the beginning of May and commences to bore its galleries between the bark and wood of deodar trees, choosing by preference sickly trees, which, if young saplings, it bores into towards the base. In the case of older poles, it is found all over the stem. In the middle of May young larvæ are to be found and the beetles from these would appear to issue about the end of July and in August. They at once pair and re-start the work, and a fresh generation is gone through, larvæ being present through September and beetles issuing about October. It is probable that a portion of the larvæ of this second generation hibernate as such, only a certain number of the earlier developed ones going on to the beetle stage.

---

[1] This beetle was first reported as infesting deodar in the Bashahr Division, Punjab, in August 1900, by Mr. Minniken, Deputy Conservator of Forests. Mr. Ribbentrop, then Inspector General of Forests, went up and studied the attack. Further notes on its life history were made by the writer in May-June 1901.

The over-wintering larvæ were discovered by Mr. Ribbentrop curled up in the end of their galleries in the pupa-cradle. In other cases he found a hole at the end of the larval gallery through which the perfect beetle had made its exit from the tree. It will not unlikely be found that the October beetles bore a little way into the bark of fresh trees and hibernate in it through the winter, coming out in May of the following year and boring into fresh trees to lay the eggs of the first generation of the year.

Localities from which reported.

The insect was first discovered by Mr. Minniken in the deodar forests of the Bashahr State in August 1900. The following year the writer found it in deodar trees in the Jaunsar division of the North-West Provinces some 100 miles or so to the south-west of the area in which it was originally discovered.

Relations to the Forest.

The discovery of this *Scolytus* is of some scientific interest, since I am not aware that the genus *Scolytus* has previously been reported as attacking conifers in India. It does not do so in Europe, where it confines its attacks to broad-leaved trees, although it has been reported from America in this connection.

The beetle up to date has only been found attacking pole forest, boring galleries which are partly in the bark and partly in the outermost layers of the wood of the trees.

The mother gallery is from 2½ to 3¼ inches in length, ascending and vertical, consisting of a series of short zig-zag curves along both sides of which small notches are gnawed out and an egg deposited in each. The secondary galleries ramify from it in a most graceful manner, the ones taking off from the centre portion of the main gallery being at right angles, whilst those more remote trend away from these at ever-widening angles, the upper ones in an upward direction, the lower ones in a downward one. These galleries are not broader at their ends than the mother gallery; they lie close together and are long, sometimes as much as 3½ to 4 inches though generally about 3 inches in length. See Pl. IV, fig. 4, *c*. Pupal chambers are excavated in the bark or sap wood.

As in the case of most bark beetles, this *Scolytus* probably prefers to attack sickly trees in preference to healthy ones, but in several instances in Jaunsar I cut them out of trees which, as far as external appearances showed, were quite healthy. That the insect is liable to increase in large numbers under favourable conditions and then infest healthy trees would appear to be the case from the 1900 attack in Bashahr. Two areas were very badly attacked, the spots being at some distance from one another and the trees in the neighbourhood of each infested portion being nearly, if not quite, free from the beetle.

I was enabled to inspect some of the poles which had been cut out (and barked) from one of these areas. They were a remarkable sight. Poles 20—25 feet in length of bole (minus top which had been cut off before extraction from forest) and with a girth of 4½ feet at base, were covered their entire length and girth with the scolytid galleries, the mother galleries being at times so close that the larval secondary ones interlaced, all trace of the symmetrical pattern of the scolytid being thereby lost. There could be no doubt of the ultimate cause of death of these trees. The whole of the cambium layer had been riddled by the beetles and their larvæ.

Protection and Remedies.

At this stage of our knowledge of the life history of this pest I can add nothing to the preventive measures instituted in Bashahr under the advice, I believe, of Mr. Ribbentrop.

The origin of the attack was attributed by him to the large number of suppressed and consequently sickly trees in the pole forests.

On both the areas attacked all infested trees were cut out, each one was barked and the bark burnt. In addition to this, each stump was barked and this bark also burnt. Trenches were then dug round the stumps. This latter part of the protective measures was superfluous. Bark beetles only leave the trees by flight. The grubs, as their life history shows, never leave them. Six hundred trees were thus removed from one of the infested areas and fifty from the other, watchers

having been posted to give notice of fresh trees attacked. Mr. Minniken reported towards the end of 1900 that no new trees been had infested after the completion of the preventive measures undertaken.

In 1901 the writer made a close inspection of portions of these areas, stag-headed and diseased trees being felled here and there and carefully examined. The watchers of the previous year, who were thoroughly well acquainted with the beetle's method of attack, also aided this search, but no beetles, pupæ, or larvæ were to be found in the trees inspected. This inspection was made at the end of June. It is too early yet, without further study of the habits of the insect, to say definitely that the preventive measures instituted nipped in the bud what might have proved a serious attack of this pest, but I am of opinion that had not the areas been so dealt with, there is every probability that the beetles would have multiplied and spread in all directions from the two infested centres.

Points in the life history requiring further observation.

1. The number of generations in the year. It is probable that this will vary at different elevations. Is there a spring generation at the higher elevations?
2. The length of time spent in the various stages of larva, pupa, and beetle.
3. In which stage is the winter passed?
4. What insects prey upon these beetles and their larvæ in their burrows?

An Insect Enemy of Scolytus sp.

PREDACEOUS CLERID LARVA.

Classification:—Order, **COLEOPTERA**. Family, **Cleridæ**.

Accompanying the *Scolytus* beetles found in Bashahr were a number of long fleshy-pink larvæ from a $\frac{1}{2}$ to $\frac{5}{8}$ of an inch long and provided with strong, flat mandibles, twelve distinct rings to the body, the last one ending in two hooks. See Pl. IV, fig. 5.

These larvæ are carnivorous and in all probability prey upon the *Scolytus* grubs. Whether they also attack the beetles or these latter are attacked by the clerid beetles, which is more probable, has yet to be discovered.

These larvæ exercise no doubt a check on the rapid multiplication of this pest, and their protection, whenever possible, is to be desired.

Nothing further on the subject of this insect's life history is at present known, and the beetle has not yet been found. The writer will be glad to receive notes and specimens on the various stages of its life history.

Wood-boring Insects following the Scolytus attacks.

BUPRESTID and LONGICORN BORERS.

(*Buprestidæ* and *Cerambycidæ*.)

In a tree nearly dead but still standing, which had been badly attacked by the *Scolytus* sp. beetle during the 1900 invasion, as evidenced by the numerous galleries on the inside of

the bark and in the sap wood, I found a number of two classes of wood-borers tunnelling in the outer layers of the sap wood.

(1) *Buprestid* larvæ.—The most numerous. White larvæ from 1 to 1¼ inches long with a large head and thoracic segments, the segments following being very much smaller in girth. These larvæ were boring shallow galleries in the sap wood in which they were usually to be found with the lower part of the body doubled back on to the anterior segments. These larvæ were in all probability about 8 months old, the egg having been laid during the previous year by the parent beetle. Nothing further is known about the life history of the insect.

(2) *Longicorn* larvæ.—White larvæ, about 1 inch or a little less in length, with large head and prothoracic segments and stout, thick mandibles. The segments of the body are not very much less in diameter than those of the head and thorax. Head black, rest white in colour. No legs present. These were tunneling deeper into the wood, the tunnels being but little wider than the greatest diameter of the grub and in no way resembling those of the *Buprestid* larvæ.

I have no further observations about this insect at present.

The attacks of these buprestid and longicorn grubs follow a general rule that these insects invariably make their appearance in a tree that has been infested by bark-borers. They come at a later stage, when the bark-borers have undermined the strong vitality of the tree, and their grubs remain boring in the wood long after the tree has been deserted by its first invaders. The fresh bark is necessary to many of the young longicorn and buprestid grubs whilst their mandibles are still small and tender. As they become more developed, they are capable of tackling the wood of the tree, and fresh bark is no longer a necessity or even a requirement to them, as is the case throughout the whole of the life history of the bark-borer.

The pupal and imago stages of both these insects have yet to be observed. They will in all probability both take place in the wood.

PSEUDOSPHINX DISCISTRIGA.
WLK.

References:—Wlk. Cat. viii, p. 209; Moore, Lep. Ceyl. ii, pl. 73, figs. 1, 1*a*, 1*b* (pupa and larva); C. & S. no. 176. Diludia melanomera, Butl. P. Z. S. 1875, p. 13; C. & S. no. 177. Diludia macromera, Butl. A. M. N. H. (5) x, p. 435. Diludia grandis, Butl. P. Z. S. 1875, p. 260; C. & S. no. 175. Diludia rubescens, Butl. P. Z. S. 1875, pp. 260, 623; C. & S. no. 178. Macrosila obliqua, Wlk. Cat. viii, p. 208; C. & S. no. 174. Anceryx nicreta, Wlk. Cat. xxxi, p. 36; C & S. no. 179. Diludia vates, Butl, P. Z. S. 1875, p. 13; C. & S. no. 180. Anceryx pinastri, Wlk. Cat. viii, p. 223. Hmpsn Faun. Br. Ind. Moths i. p. 105, no. 169.

Classification.—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Sphingidæ.

Description.

Larva.—The general colour of the caterpillar is a pale lemon yellow or sap green. The first three segments are studded with whitish specks raised in relief on the surface. The last segment of the body and the horn are also similarly studded with these raised dots of colour; a longish red horn on the last segment but one is also studded with the whitish specks of colour. Head green with a diagonal transverse stripe running from top of head outwards on either side. On the dorsal surface of the body are a series of green lateral lines starting from the centre of the dorsal surface and running forwards and outwards down over the side of the body. On the portions of these lines extending down the flanks of the insect they are bordered for a short distance by short purple-red lines above, and below by a white line along their entire length. From the base of the horn is projected on either side outwards and forwards a whitish line bordered with purple. The prolegs are reddish purple. Clasper legs white. The above description is that of a three parts grown larva. The colours darken slightly as the caterpillar matures, and in the case of one specimen I kept the white, green, and purple diagonal streaks up the two sides of the dorsal surface merged into reddish

purple square patches of colour, the white and green being entirely lost. Larva when full grown is a large, thick-built caterpillar of 3 inches in length.

Moth.—A stout large moth of a general greyish appearance, but with considerable variation in colouring and markings. Hampson describes it as follows :—

Head, thorax, abdomen, and forewing grey; dark brown bands along sides of palpi and thorax meeting on metathorax, where there are a few blue and yellow scales; a dark line down vertex of abdomen and paired more diffused subdorsal lines. Forewing with some dark strigae from the costa; two dark streaks in the interspaces below veins 2 and 3; a dark streak from the costa before the apex, curved down to vein 6, then upwards and bent back before reaching the apex; a series of submarginal lunules; cilia chequered brown and white. Hindwing brown, with a pale patch with two dark lines across it near anal angle. Under side paler, with indistinct transverse lines.

There are four well-marked varieties which are not locally constant :—

(1) *rubescens*, a dark red-brown form with a prominent oblique black streak from costa of forewing to lower end of cell; hind wing very dark;

(2) *discistriga* = *melanomera* = *macromera* = *grandis*, a grey form, much powdered and suffused with dark brown;

(3) *obliqua*, a whitish-grey form with a prominent black streak on fore wing as in *rubescens*, but continued to the outer margin; hind wing very dark; the patch at anal angle remaining pale;

(4) *increta* = *vates*, a pale form, but slightly powdered with brown.

Expanse of wings 90—140 millim. See Pl. II, fig. 1.

Life History.

The larvæ of this moth are to be found feeding on teak leaves towards the end of July, at which period they have been found of all sizes up to nearly, if not quite, full grown. It is

probable that the young make their first appearance when the teak is putting on its new foliage somewhere about the beginning of the month. Sphingid larvæ are, as a general rule, by no means either very common or gregarious in their habits. This rule does not apply to *P. discistriga* which was exceedingly plentiful on teak in Berar in July 1901, swarming over the trees and feeding voraciously and wastefully. It apparently rarely entirely finishes a leaf, eating from ⅓ to ⅔ only and then seeking a fresh one. When feeding, it eats straight on through all the ribs and minor veins of the leaf and thus its attack can be easily distinguished from those of its ofttime companions *Hyblæa puera* and *Pyrausta achœralis*. It is to be found at all elevations between 1,800 feet, and 2,900 feet, and at the latter elevation appeared to almost entirely take the place of *H. puera* and *P. achæralis*. The caterpillar when alarmed takes up a characteristic attitude, raising the first few segments of the body and curling them over downwards so as to roll up and protect both head and prolegs. As its growing period is during the rainy season, it is perhaps natural that it should be unaffected by rain. I have watched it feeding unconcernedly in the heaviest of tropical showers, and I noticed them to be numerous on the trees on the morning after a 6 inch fall of rain during the night.

One moth, just issued from the chrysalis and with wings still unexpanded, was found on August 3rd.

I think it is improbable that this insect has more than one generation in the year, but further observation is required on this point.

Localities from which reported.

Larvæ of this insect were exceedingly plentiful in the Melghat teak forests, Berar, in July 1901. A few specimens and one moth were also found in the Central Nursery, Poona, at the beginning of August during a visit made there with Mr. Wroughton, Conservator of Forests

Mr. Williamson, Deputy Conservator of Forests, informed me that the insect is to be found generally throughout the Melghat teak areas. Hampson gives the habitat of this moth as Chinat, throughout India and Ceylon.

Relations to the Forest.

P. discistriga is to be found defoliating the teak in company with the two well known defoliators *Hyblæa puera* and *Pyrausta achæralis.* Its own attacks can be easily recognised by the large irregular shaped holes eaten out of the leaves, all veins being indiscriminately consumed. The attack thus differs very considerably from that of its companions, the former of which leaves untouched the chief and side veins, eating everything else, whilst the latter feeds only on the parenchyma, leaving all veins untouched. Mr. Williamson, who has eight years experience of the Melghat forests, informed me that he has noticed them as constantly present on the teak at the beginning of the rains, and he is of opinion that this caterpillar does more general defoliating damage at that time in those forests than either of its companions. In 1897, he noted that 90 per cent. of his teak areas were entirely defoliated in August and September, but he is not able to say which of these three species was most responsible. They appeared to feed equally upon both young and old trees and eat old and new leaves indiscriminately. I occasionally found it on other trees, but teak is its chief host.

Protection and Remedies.

This pest requires further study. I noted that the larvæ appeared to be heavily parasiticised, but I am not at present able to say whether the parasites were Hymenopterous or Dipterous flies.

In the Poona nursery the young insects were said not to be numerous : should they become so, I recommend the spraying of the young plants with the arsenical powder Paris green.

Points in the life history requiring further observation.

1. Where the eggs are laid. Is it on the twigs of the teak ?
2. Length of time spent in the larval stage.
3. Length of time spent in the pupal stage and where the larva pupates.
4. Length of time spent in the imago stage.
5. How the insect passes the cold weather months. Is it in the egg stage?

CLANIA CRAMERI.[1]

WESTWOOD.

References:—Westw. P. Z. S. 1854, p. 236; Moore, Lep. Ceyl. ii, pl. 118, figs. 1, 1a (larva-case); C. & S. no. 490. Hampsn. Faun. Br. Ind., Moths, I, p. 291. no. 617.

Classification:—Order, **LEPIDOPTERA.** Sub-Order, **HETEROCERA.** Family, **Psychidæ.**

Description.

The *larva* lives within a small case of longitudinally arranged twigs which it carries about with it like a snail carrying its shell. The larva adds to this case as it grows, but never leaves it. See Pl. II, fig. 2 a.

The *pupa* is formed within the case of twigs, in which it remains if the insect is a female, this sex being practically wingless.

Moth. ♂.—Head, thorax and abdomen clothed with light and dark brown hair. Antennæ bipectinated to tips. Fore tarsus with the terminal joint long; tibia with a long spine. Fore wing red-brown, the veins streaked with black; the interspaces with pale streaks; more or less fuscous suffusion on outer area. Hind wing smoky brown. Wings rather short and broad.

Expanse of wing 30 millim. See Plate II, fig. 2, *b*, *c*.

Life History.

The larvæ hatch out in July and at once commence to feed on the needles of the *Pinus longifolia*, which tree this insect defoliates. The caterpillars are voracious eaters and continue feeding upon the needles until November. Trees of all ages are attacked.

---

[1] This insect was found in 1898, in the Jaunsar Division, North-Western Himalayas, by Mr. B. B. Osmaston, F.C.H. The observations on the life history were made by him. Some old larval cases were sent to the Indian Museum in June 1897, by Babu Sadanand Gairola, from the Jaunsar Division.

The winter is passed probably in the larval or semi-pupal state. Perfect pupæ are to be found within the twig cases in April of the year succeeding that in which the defoliation takes place.

The moth appears in June. It is probable that only the male moth is to be found on the wing in the forest, the ♀'s of this family being wingless insects never quitting the twig case in which, after being fertilised by the male, they lay their eggs.

Plate II, fig. 2, *b*, shows the case made by the larva with the pupal case of the male protruding from it, the insect having escaped; fig. 2, *c*, the ♂ moth.

Area from which reported.

This insect was reported from the Jaunsar forests in the North-Western Provinces in 1898.

Hampson in the Fauna of British India gives Ceylon as the habitat.

Relations to the Forest.

This insect occasionally does a large amount of damage to *Pinus longifolia* by stripping the trees of their needles.

It is apparently to be found to a greater or less extent every year in forests consisting of this tree, but in 1898 it was particularly numerous, doing a vast amount of damage to trees of all ages.

Points in the life history requiring further observation.

1. Where the eggs are laid. It will probably be found that they are laid by the wingless female moth within her pupal case inside the twig case made by the larva.
2. Where the larva hangs up or fixes its twig case before changing to the pupal state. This is important since on it depends to a great extent the fact as to whether any remedies are possible in nurseries and plantations in which this pest might appear plentifully.
3. The exact stage within the twig case in which the insect passes through the winter. Is it the larval, semipupal or pupal stage?

SUANA CONCOLOR,

WLK.

References :—Wlk Cat. vi, p. 1463; C. & S. no. 1508; Lebeda bimaculata, Wlk. Cat. vi, p. 1463; C. & S. no. 1506; Moore Lep. Ceyl. ii, pl. 140, figs. 1, 1*a*, *b* (larva); Suana ampla, Wlk. Cat. vi, p. 1502; C. & S. no. 1505; Suana cervina, Moore, P. Z. S. 1879, p. 410; C & S. no. 1507. Hmpsn. Faun. Br. Ind. Moths, I, 406. no. 903.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Lasiocampidæ.

Description.

The larva is a pale greyish-brown in colour covered with numerous black striæ; the second and third segments with raised dorsal humps covered with close black or dark brown hair; immature specimens have small white-haired dorsal papillæ on the fourth to the tenth segments, each with a pair of red brown papillæ in front and a pair of crimson papillæ on each side; the eleventh segment has a black dorsal tuft; there are lateral brownish tufts on each segment; the head is longitudinally banded with black. (This description, which differs slightly from Hampson's, is that of living specimens.) Pl. V, fig. 1, *a* shows the larva of this insect.

The larva when pupating spins a long semi-elliptical cocoon grey to grey-brown in colour consisting of coarse silk and hairs from its own body and some 3½ to 4 inches in length. (Fig. 1, *b*.)

The *pupa* is black, shining, slightly concave dorsally and 1 to 1·25 inches long. The pectinate antennæ of the future moth can be seen outlined on the pupal skin.

Moth. ♂. Head, thorax, and abdomen dark red-brown. Fore wing dark red-brown, the costa greyish; a more or less distinct yellowish subbasal spot; a silvery-white spot at end of cell; two antemedial, a medial, and two postmedial dark waved lines; a submarginal lunulate line, with yellow marks more or less prominent in the undulations. Hind wing dark red-brown.

Some specimens lose the white spot and others are very dark. Expanse of wings, 52—64 millim.

♀. Much paler; the markings similar; fore wing with a small grey patch at the base.

The form *ampla-concolor* has lost the white spot at end of cell of fore wing which is present in *bimaculata*; all the intergrades are to be found. Expanse of wings 106—146 millim. Pl. V, fig. 1, *c*, shows the pupa, *d*, the moth of this pest.

Life History.[1]

The moth appears on the wing at the end of March and beginning of April in Northern India. It is not known as yet where it lays its eggs, but it will be probably found to be somewhere on or near its food-plant which is the sâl tree (*Shorea robusta*, Gaertn.). When the young larvæ come out of the egg is not known, but towards the end of October they are nearly full grown and pupate about the middle of November. They spin a tough, stout cocoon of coarse silk mixed up with much of their own hair which they fix either in crevices of the rough bark of the stems of large trees or to branches, twigs, or beneath the bark of the trees. The winter is passed through in this stage, the moth appearing, as already stated, at the beginning of April.

Localities from which reported.

The insect is common in the sâl forests of the Eastern Dùn in the North-West Provinces. Hampson gives throughout India and Ceylon, Philippines and Java as the habitat of this moth.

Relations to the Forest.

The caterpillar defoliates the sâl and at times this defoliation would appear to be somewhat heavy. Further observations are however, required on this point since this tree has apparently many defoliating pests, and it is necessary to determine which are those to be the most feared.

Observation has, however, led me to the conclusion that it will not unlikely be found that the sâl defoliators of Assam

---

[1] These observations were made by Mr. F. Gleadow, Deputy Conservator of Forests, Student Subramarian, and the writer.

and Eastern Bengal differ from those attacking the same tree in Madras and the Central Provinces, and that both these would seem to differ from those to be found in the Siwalik sâl forests of the North-West Provinces.

Protection and Remedies.

The pupæ in their long semi-elliptical shaped cocoons are so easily seen that in nurseries and plantations, when this insect is giving trouble, their collection should be enforced, all cocoon cases with their contents being burnt or destroyed in some suitable manner. Until the life history of the larva is, however, known, it is not possible to state how it might be best attacked.

Points in the life history requiring further observation.

1. Where the eggs are laid?
2. When the young caterpillars hatch out? Length of time spent in the larval stage?
3. Is there more than one generation in the year—
   (i) In the Siwalik sâl forests?
   (ii) In other warmer parts of India?

TRABALA VISHNU.[1]

LEF.

References:—Lef. Zool. Journ, iii, p. 207; C. & S. no. 1456; Moore, Lep. E. I. Co. pl. xxii, figs. 3, 3b (larva) Gastropacha sulphurea, Koll. Hügel's Kaschmir, iv, p. 471; C. & S. no. 1449; Trabala mahananda, Moore, P. Z. S. 1865, p. 821; C. & S. no. 1454; Amydona basalis, Wlk. Cat. vi, p. 1415; Amydona prasina, Wlk. Cat. vi, p. 1417. Amydona pallida, Wlk Cat vi, p. 1417; Hmpsn. Faun. Br. Ind. Moths. I. 421; no. 936.

Classification:—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Lasiocampidæ.

Description.

Larva. Head yellow, spotted with red; the body colour brownish grey, with long lateral tufts on each segment; that on the first black and grey, the others grey; paired dorsal and lateral black spots on each segment, from which spring long black hairs, the spots on the thoracic segments coalescing.

Another form of the larva is blackish with a broad white dorsal stripe, the anterior tufts red-brown.

A third form is reddish with the lateral spots blue.

Cocoon is ochreous in colour, with short black hairs projecting from it, which are intensely irritating.

Moth. ♂. Pale apple-green; antennæ ochreous brown, the disk of fore wing and inner margin of hind wing whitish; fore wing with a faint pale antemedial line curved below the costa; a dark speck at end of cell; a pale straight oblique postmedial line, which becomes medial on the hind wing; both wings with a series of small submarginal dark spots. Pl. V, fig. 2, shows the male moth.

♀. Yellowish green, which fades to ochreous; the lines and spots of both wings enlarged and blackish; the spot at end of cell of fore wing large, conspicuous, and irrorated with black scales, and sometimes centred with grey; a red-brown patch

---

[1] This insect was reported to be defoliating sâl forest near Dubri, Assam, in company with *Lymantria grandis* and *Dasychira* sp., by Mr. J. Campbell, Deputy Conservator of Forests.

thickly irrorated with black occupying the whole medial inner area from the median nervure to inner margin ; cilia of both wings blackish.

Expanse of wings ♂ 50—60 ; ♀ 80—90 millim.

Hampson gives the habitat as China, throughout India, Ceylon, Burma, and Java.

Life History, etc.

In Assam the larva of this moth is to be found in the sâl forests during April-May, and apparently does a certain amount of defoliation. The moth appears on the wing in June and was sent to the Indian Museum in 1898 from the sâl areas near Dubri where it was defoliating the trees in company with *Lymantria grandis*. No further accounts of this insect's life in the forest are at present available. It is probable that there will be at least one other generation of the insect during the year about August September.

This adds one more to the lengthening list of sâl defoliating *Heterocera*, and observations are required as to which of the species are reponsible for most of the damage done.

Points in the life history requiring further observation.

1. Where the eggs are laid. Are they laid on the sâl twigs?
2. The time spent in the larval stage.
3. The time spent in the pupal stage.
4. The number of generations in the year. If more than one, the times spent in the various stages of each generation.
5. Where the insect spends the winter, and in which stage of its metamórphosis.

DASYCHIRA SP.

References:—Ind. Mus. Notes, V. 1, 33.

Classification:—Order, **LEPIDOPTERA.** Sub-Order, **HETEROCERA**, Family, **Lymantriidæ.**

Description.

No description of this pest appears to have been published.

The caterpillars of the genus are, however, hairy and the pupa is formed in a silken cocoon.

The moths are medium sized, the male smaller and more brightly coloured than the female.

The palpi of these insects are porrect, the second joint heavily fringed with hair, antennæ with the branches long in male, short in ♀; legs hairy. Fore wing with the outer margin oblique.

Life History.[1]

The larvæ of this moth made their appearance in a portion of the Assam sâl forests in August 1897, and, despite the very heavy rainfall which followed the great earthquake which had taken place the preceding June, did a certain amount of defoliation.

This generation did not spread much but in the following November a second generation of the larvæ appeared, and in company with other species of caterpillars spread greatly. A third generation of larvæ appeared about the end of January, the number of caterpillars being reported as enormous. Towards the end of March yet a fourth generation of the *Dasychira* appeared, and the pests did not finally disappear until May. Caterpillars of this fourth generation collected on the 23rd March, changed into the pupal stage on the 30th and 31st March, and an imago emerged on the 20th April 1898.

It would appear that the two first of these generations took some 8 weeks to pass through the various stages of their

---

1 *Vide* Ind. Forester Vol. XXIV, 9 (1898).

metamorphoses, whilst in the case of the last two, six weeks sufficed from egg to mature moth.

The life history from May to August has still to be studied.

Locality from where reported.

The insects were sent from the Goalpara district in Assam.

Relations to the Forest.

The sal was completely defoliated throughout this district in 1893-94. This was repeated in 1897-98, the *Dasychira sp.* appearing towards the close of August in the Hil and Charaidaka blocks. In November the area affected extended over the greater portion of the Ripu Reserve and on into Chirang. The third generation in January was the most mischievous, invading almost every sâl tree throughout the Goalpara division. Early in March the sal forest presented the appearance of a mere mass of upright bare poles, without a vestige of foliage on them except in the case of a few young trees near the Bhutan border on the west of the district which escaped attack. When the leaves of the trees should have fallen, none were left to fall, all having been devoured. The inflorescence which usually appears about the close of January or early in February failed to develop at all. With reference to this, it is stated that the Guma Reserve, about 26 square miles in extent, where the insects were few in number, was a mass of foliage and inflorescence in March, prognosticating an excellent seed season, when this pest appeared in thousands and cleared off both leaves and flowers. New shoots and leaves started sprouting in March and were left untouched till the end of the month when the fourth generation cleaned them off the trees. Other trees suffered as well as sâl but to an insignificant extent, except the few *Terminalia tomentosa* in the west of the district which were stripped in a similar manner to the sâl.

The damage done to the trees is serious. Growth is arrested, numerous young shoots and twigs die, and it is stated that the number of unsightly knots on branches have their origin in this manner. Poor soils and shallow exposed situations and ill-grown trees are first attacked, but depredations are not limited to these, and the defoliation is said to become so com-

plete that not a vestige of a leaf is left. The numbers can only be imagined from the area worked over, which in the Reserved Forests alone exceeded 500 square miles.

Dasychira was accompanied by *Leucoma diaphana*, Moore, during the August attack; by *Trabala vishnu*, Lep., during the last or May generation; and by *Lymantria grandis*, Wlk. throughout all its generations, the latter being as numerous and active as the *Dasychira*.

The first mention of these great defoliating attacks was made by Mr. W. R. Fisher in 1878, the next reference being 14 years later in 1892.

Protection and Remedies.

As would be expected, these hordes of caterpillars are infested by numerous parasites, although little is at present known about them. Great difficulty was, however, experienced at the time in breeding out moths from the larvæ owing to the parasitical attacks to which they were subject. It is stated that in spite of the vigour and numbers of the larvæ, one should rather say by reason of it, these parasitic attacks increased, and whilst the larvæ were swarming in thousands, large numbers were seen to be in a sickly condition. Red ants are said to have been attracted and to have helped to kill off the larvæ.

Enquiries made seem to point to the fact that these attacks have become more serious since wholesale fire protection was introduced by the Department. This latter is said to have become only really effective over the sál areas in this part of Assam in 1891, and it is since then that the insects have returned annually in larger or smaller hosts. It is impossible without further careful recorded observations to say what truth there may be in this theory. It is, however, certain that serious attacks by insect pests did occur in the old days before fire protection and equally so that very little attention was at that time paid to defoliating or other insect attacks.

Points in the life history requiring further observation.

1. Where the eggs of each generation are laid.
2. The exact length of time spent in the egg, larva, pupa, and moth stage of each generation.

3. What becomes of the insect between May and August? Is it in the egg stage during this period, and if so, where are these eggs laid?
4. The identification of all the caterpillars which accompany the *Dasychira* in its various generations is required.[1]

[1]*Note.*—I shall be much obliged if specimens of all stages of all these defoliating pests could be sent to me to Dehra Dun, with a full note as to locality obtained from, with elevation, nature of forest (*i.e.*, pure or mixed, good or poor), the amount of damage done, and dates of appearance, etc.

LYMANTRIA AMPLA,

WLK.

References :—Wlk. Cat. iv, p. 883; Moore, Lep. E. I. Co., pl. 9 a, fig. 4, and pl. 15, figs. 7, 7a, 8, 8a (larva); C. & S. no. 1028, Hmpsn. Faun. Br. Ind. Moths, I, 460, no. 1028.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA, Family, Lymantriidæ.

Description.

The *larva* is brown in colour and clothed with tufts of short hair and long hair from the anterior and posterior segments; male with a pale subdorsal line and dorsal and lateral white spots; female with black dorsal spots and a white spot on the ninth segment. Head and legs ochreous.

Moth, ♂. Palpi hairy. Head, thorax, and abdomen yellow brown, legs spotted with black. Fore-wing greyish-brown; a black sub-basal line with some spots beyond it; an antemedial waved line; a spot at middle of cell and lunule at end of it; a diffused postmedial band and double waved postmedial line. Hind wing brown, with an indistinct waved postmedial line; an elongate black mark near anal angle; cilia of both wings spotted with black.

♀. Antennæ serrate. Head, thorax, and aborted wings white, spotted with black; abdomen blackish.

Expanse of wings 40 millim.

Life History, etc.

This insect is a very close ally of the well known destructive European pest *Lymantria* (*Liparis*) *monacha*, Linn., and it is therefore recorded in these notes. At present little is known of its life history in India, although it exists throughout the entire continent as also in Burma and Ceylon. It has proved a destructive defoliator to the Peepul tree (*Ficus religiosa*) in Calcutta.

LYMANTRIA OBSOLETA,

WLK.

References:—Wlk. Cat. iv, p. 880; C. & S. no. 1014. Lymantria bhascara, Moore, Lep. E. I. Co., p. 345. Lymantria vinacea, Moore, P. Z. S. 1879, p. 402. Lymantria albolunulata, Moore, P. Z. S. 1879, p. 403; C. & S. no. 999. Lymantria sobrina, Moore, P. Z. S. 1879, p. 402, pl. 33, fig. 5. Hmpsn. Faun. Br. Ind. Moths, Vol. I, p. 461. no. 1031.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Lymantriidæ.

Description.

General colour of the moth is brown with black markings. The head and thorax black. Hampson describes it as follows:—

♂. Head and thorax brown; abdomen slightly tinged with crimson. Fore wings irrorated with dark scales; indistinct, double lunulate antemedial, medial, and postmedial lines; a black lunule at end of cell, but no spot in the cell. Hind wing pale brownish fuscous.

♀. Abdomen crimson, with a dark line on vertex and series of black spots, the extremity brown; hind wing with the inner area suffused with crimson.

The form *albolunulata* from the North-West Himalayas has the fore wing more irrorated with black; the postmedial lines with whitish lunules between them. A form from the Khasís has the ground-colour of fore wing paler; the hind wing nearly pure white, with a fuscous lunule at end of cell and irregular sub-marginal band; the cilia of both wings chequered black and pinkish.

In the form *sobrina* the lines of the fore wings are better defined; the hind wing with the inner margin tinged with pink; female with the abdomen yellowish.

Expanse of wings: ♂ 42, ♀ 72 millim.

Areas from which reported.

This moth was plentiful in 1899 in the sál forests of the Jalpaiguri Duars situated at the foot of the North-East Himalayas in Bengal. (Sir H. A. Farrington, *Bart.*)

It has a wide range as Hampson gives its habitat as China, Formosa, and throughout India and Ceylon.

LYMANTRIA TODARA

MOORE.

References :—Moore, P. Z. S. 1879, p. 402, pl. 33, fig. 6; Hmpsn. Ill. Het viii, pl. 141, fig. 15 (♀); C. & S. no. 1020. Hmpsn. Faun. Br. Ind. Moths, Vol. I, p. 463. no. 1035.

Classification :—Order, **LEPIDOPTERA.** Sub-Order, **HETEROCERA.** Family, Lymantriidæ.

Description.

A largish moth with white wings with blackish markings white head and thorax, black antennæ. Hampson thus describes it :—

♂. Head and thorax white; antennæ black; a yellow line behind the head; two black spots on collar; and four on vertex of thorax; abdomen yellow. Fore wing with the postmedial waved lines single towards inner margin. Hind wing pale yellow, with a fuscous marginal band.

♀. Abdomen yellow and black. Fore wing with the waved lines absolescent; the black patches on costa and inner margin large and well defined, the first three on costa crossing the cell; a patch on centre of outer margin; the one on inner margin Y-shaped. Hind wing fuscous white, slightly tinged with yellow; the sub-marginal band almost obsolete.

Expanse of wings: ♂ 54, ♀ 88 millim.

Areas from which reported.

This moth was found in company with *L. obsoleta* in 1899 in the sál forests of the Jalpaiguri Duars at the foot of the North-East Himalayas in Bengal. (Farrington). Hampson states that it has also been reported from the Nilgiris and Ceylon.

LYMANTRIA MATHURA,

MOORE.

References:—Moore, P. Z. S. 1865, p. 805; C. & S. no. 1026. Lymantria aurora, Butl. A. M. N. H. (4) xx, p. 403. Hmpsn. Faun. Br. Ind. Moths, I, pp., 464—465. no. 1038.

Classification:—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Lymantriidæ.

Description.

♂. Head and thorax pale fuscous, marked and spotted with black; the line behind the head yellow; third joint of palpus orange; two orange spots on mesothorax; abdomen orange with black spots on its vertex; anal tuft black. Fore wing very pale fuscous; an orange speck and thin black spots at base; a broad subbasal black band; an antemedial line; a spot near end of cell and lunule on discocellulars; a median band; two postmedial and one submarginal lunulate line; a marginal series of spots. Hind wing orange with a black spot at end of cell and conjoined series of submarginal spots forming a curved band; some spots on centre of outer margin.

♀. Head and thorax white; frons fuscous; two black spots each on collar, meso, and metathorax; palpi, antennal tuft, and two spots on mesothorax crimson; abdomen crimson, with small black spots on vertex, the terminal segments whitish; legs, black and crimson. Fore wing white; some crimson and black basal spots; a subbasal line; an antemedial waved line joining at inner margin two postmedial lunulate lines, the space between which is often completely filled in with fuscous; a fuscous spot towards end of cell; some lunulate submarginal marks forming a more or less complete band; a marginal series of spots; costa and cilia crimson. Hind wing crimson, with a fuscous spot at end of cell; a sub-marginal maculate band and some spots on centre of margin. Expanse of wings: ♂ 40—54, ♀ 96—112 millim.

Areas from which reported.

This pest was found in company with *Lymantria obsoleta* and *L. todara* in the sál forests of the Jalpaiguri Duars in Bengal. (Farrington.)

Hampson also gives Japan, North-West Himalayas and Sikkim as its habitat.

LYMANTRIA BIVITTATA,

MOORE.

References :—Moore, Lep. Atk., p. 57; C. & S. no. 1022. Hmpsn. Faun. Br. India, Moths, I, p. 466. no. 1043.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Lymantriidæ.

Description.

♀. Head and thorax white; palpi and antennæ black; frons tinged with crimson; basal joints of antennæ and line behind the head crimson; abdomen crimson, the basal and terminal segments white. Fore wing silvery white; two black basal marks; an outwardly oblique antemedial line with waved edges, joined at inner margin by an inwardly oblique antemedial line with waved edges joined at inner margin by an inwardly oblique postmedial line; a series of marginal spots. Hind wing white. Expanse of wings 100 millim.

Areas from which reported.

This moth was found in company with *Lymantria obsoleta, L. todara, and L. mathura* in the sál forests of the Jalpaiguri Duars at the foot of the North-East Himalayas. (Farrington.)

Hampson also gives Sikkim and Sylhet as its habitat.

Description of eggs and larva.[1]

The *eggs* are apparently laid in masses on the bark, the individual eggs being stuck together by an excretion of the female. Dried specimens are small, round, silvery little globes, about as large as an ordinary sized pin's head which they greatly resemble. No description of the *larvæ* of the above four Lymantriid moths was made at the time of the reported attack. It may, however, be noted that the caterpillars of the family

---

[1] It is at present doubtful as to which of the many different kinds of larvæ sent in connection with these attacks produce the various species of Lymantria moths above described. They have therefore been dealt with collectively.

Lymantriidæ are hairy, being generally clothed with very thick hair or with thick tufts of hair.

The *pupæ* are described as being formed within cocoons, the latter consisting of the caterpillar's hairs fastened with a very small quantity of silk.

I have taken these four moths together since no data are at present available as to which larva is the most abundant and their descriptions are still required.

Life History.[1]

The caterpillars probably make their appearance some time during the latter part of August, since the defoliation of the Mairaghat Forest was observed to be complete about the middle of September.

Some larvæ were collected on 22nd September and placed in a box under observation. On the 4th October pupation commenced, both amongst the caterpillars in the box and generally amongst those in the forest, the caterpillars being full-fed about the end of September.

Caterpillars were, however, to be found in small numbers in the forest after October 4th.

The insect remained in the pupal stage for about nine days, the first *moths* emerging on the 13th October. From the above descriptions of the latter it will be noticed that the females are generally larger than the males.

Eggs were laid by the females in about two days after fertilisation which took place almost as soon as they had left the cocoon and become fully developed. After egg laying the female moths died.

This is at present all we know about these life histories. I am of opinion that it will probably be found that this Septem-

[1] The specimens of these insects were sent to me in December 1899 be Sir H. A. Farrington, Bart., from the Jalpaiguri forests, Bengal, of which he was in charge. The notes on the life history which he sent me were, he says, drawn up by his Range Officer Babu L. R. Sen. No observations were made before the middle of September as the Ranger was away on leave till then, and Sir Henry did not visit that portion of his division till October. On the Ranger's return he found the sál trees in his range leafless, the defoliation being due to caterpillars of the above described moths.

ber generation of the pest was not the first one of the year, and investigation will not improbably show that there is at least one, if not more, earlier generation. The forests should be carefully watched at the time the spring crop of leaves is appearing on the sál and other trees attacked.

Relations to the Forest.

Whilst the insects are to be found on other species of trees common to sál areas, the heavy defoliation accomplished by them appears to be chiefly confined to sál trees. Both sál standards and sál coppice were completely defoliated in the attack of 1899, whereas coppice of other species escaped to a great extent. The damage is of the most serious nature, since as soon as the trees lose their crop of leaves and become leafless, all growth is stopped and the annual increment put on by the tree greatly lessened. The defoliated sál trees commenced putting on new leaves about 1½ months after they were completely stripped.

Sir Henry states that the caterpillars did no damage in evergreen forest and little in mixed forest.

The following trees, amongst others, were also attacked:—

Lagerströmia parviflora, *Terminalia tomentosa*, *T. bellerica*, *T. Chebula*, *Careya arborea* (slightly), and *Macaranga denticulata* (slightly). Neither Dillenia nor Chilauni were apparently attacked.

Protection and Remedies.

It is stated that evergreen forest was not attacked, and mixed forest only slightly, coppice of species other than sál also only slightly. On areas therefore where this insect is found to make its appearance annually once or twice in the year, I recommend that where possible mixed forest should replace pure sál. In the case of coppice, where complete defoliation is most serious since it greatly retards the growth of the young trees, which will not have reached the size expected or required of them at the end of the rotation if subject to annual or triennial attacks of these pests, a mixture with other suitable trees is also to be strongly recommended.

Points in the life histories requiring further observation :—

1. The number of generations in the year. This is most important. Is there a spring generation?
2. When the eggs are laid?
3. Descriptions of the various larvæ engaged in the attack. Which is the most numerous?
4. The life history of the insect from the time in October when the females lay eggs and die until some time during August when the autumn larvæ are defoliating the forest.
5. Careful watch should be made for larvæ when the young new leaves are appearing on the trees in the hot weather, and when new flushes of leaves appear after a heavy defoliating attack.

LYMANTRIA GRANDIS,[1]

WLK.

References :—Wlk. Cat. iv, p. 874; C. & S. no. 1008. Lymantria maculosa, Wlk. Cat. iv, p. 881. Lymantria metarhoda, Wlk. Trans Ent. Soc. (3) 1, 1862, p. 7?. Hmpsn. Faun. Br. Ind., Moths, I, p. 465. no 1040. Ind. Mus Notes, v. 1, p. 33.

Classification :—Order, **LEPIDOPTRA.** Sub-Order, HETEROCERA. Family, Lymantriidæ.

Description.

The *larva* is very hairy, of an ashy-brown colour overlying a darker hue, with two conspicuous tufts on the first segment of the body. It is about 2 inches long.

Moth. ♂. Differs from *L. mathura* (already described) in having the orange markings replaced by crimson, except that the abdomen is somewhat orange towards the extremity. The shaft of the antennæ and ground colour of thorax and fore wing are pure white.

♀. Differs from *L. mathura* in the frons being black, the second joint of palpus with a black spot.

Expanse of wings :—♂ 58, ♀ 110 millim.

Life History.

In the 1897-98 defoliating attack upon the sâl trees in Goalpara, Assam, this insect was reported as working almost contemporaneously with the *Dasychira sp.* larvæ; in other words, four generations of the larvæ appeared between the end of August 1897 and the end of April 1898, the caterpillars being present in August-September (1st generation), November (2nd generation), end of January-February (3rd generation), and March (4th generation). Notes were made in the case of

---

1 Specimens of this insect were sent to the Indian Museum in June 1898 by Mr. J. Campbell, Deputy Conservator of Forests, Golaghat Division, Assam. As the moths were much rubbed and damaged, the identifications were said to be to a certain extent doubtful.

this last generation as to the dates of appearance of the other stages of the metamorphosis, larvæ collected on 23rd March changing into the pupal stage on the 30th and 31st (as did the *Dasychira sp.*) and imagos issuing on the 10th, 11th, and 12th April.

In September of the following year specimens of the larva pupa, and moth were sent from Jalpaiguri and identified as *L. grandis.*

The specimens of the other species of Lymantria (above described) sent to me during the same year from Jalpaiguri pupated in October, the first moths appearing only on the 13th of the month, this corresponding with the 1st generation in Assam. It would therefore seem certain that either *L. grandis* appears earlier at work in the forests than its four companions, or that its larval life is shorter. Its life history between June and August requires study, as also the length of time spent in the various stages of its metamorphosis in the different generations. The larvæ are said to be possessed of great vitality and are not so parasitised as the *Dasychira sp.*

Localities from which reported.

Both the Golaghat Division in Assam and the Jalpaiguri Division in Bengal report this insect from their sál forests.

Hampson gives the known habitat of the pest as Ceylon.

Relations to the Forest.

L. grandis commits the same havoc in the sál forests as its confrères above described. This defoliation on a large scale of the Duars and Assam sál forests has been known for some years and numerous insects in various stages of decay have been sent for identification as causing the damage. Correspondence on the subject has in consequence become much confused and the identifications, in many cases often only partially attempted, very unreliable. It would be of the greatest service if, when the next attacks appear in Bengal and Assam on a large scale, the various stages of the insect are carefully watched and copious notes made whilst they are in progress in the forest. The different kinds of larvæ appearing to be concerned in the defoliation should be kept in *separate* boxes and the moths bred

out of them, species of each larva being kept separate (in spirits) with its pupa and moth (latter in small triangular paper slips). Notes should be made as to which larva appears to be most plentiful in the forest, the dates on which it appears, and the length of time it spends feeding.

If notes on the above lines are made and specimens kept, it will be possible to settle which of the many reported species are doing the greatest damage in the sál forests.

PORTHESIA XANTHORRHŒA,

KOLL.

References:—Koll. Hügel's Kaschmir, iv, p. 470; C. & S. no. 958. Euproctis subdita, Moore, P. Z. S. 1879, p. 400; id. Lep. Ceyl. ii, pl. 112, figs. 5, 5a; C. & S. no. 930. Euproctis virguncula, Wlk. Cat. iv, p. 836; Moore, Lep. E. I. Co., pl. 16, figs. 3, 3a (larva); C. & S. no. 932. Euproctis marginalis, Wlk. Cat. vii, p. 1731; Butl. Ill. Het. V, pl. 89, fig. 12; C. & S. no. 929. Euproctis subnigra, Moore, Lep. Atk., p. 48; C. & S. no. 931. Euproctis flavonigra, Moore, P. Z. S. 1879, p. 400, pl. 32, fig. 11; C. & S. no. 939. Hmpsn. Faun. Br. Ind. Moths, I, 485, no. 1106.

Classification:—Order, LEPIDOPTERA. Sub-order, HETEROCERA. Family, Lymantriidæ.

Description.

The *larva* is black, with head striped with white; the first segment with a crimson band; a dorsal series of yellow spots with a crimson line through them on the second, third, and sixth to tenth segments; first segment with long forwardly-projecting tufts of black hair; the other segments with shorter tufts.

Moth. ♂. White with a very slight fuscous tinge. Palpi long, slender, and obliquely pointed; the branches of antennæ long and brownish, and tuft orange; the whole apical and outer areas of hind wing on upperside, and the underside of both wings, except the outer margin, suffused with black. See Pl. V, fig. 3, *a b*.

In the form *virguncula* (which is the form as identified by Sir G. Hampson, Bart., to which the present note on the life history applies) the only trace of black suffusion on either wing is on the underside of costa of fore wing; in *flavonigra* the fore wing is bright ochreous, the hind wing black with the base white, the cilia ochreous; all the intermediate stages occurring. Expanse of wings 28 millim. ♀ without any black suffusion. Expanse of wings 37 millim.

Life History,[1] etc.

The larvæ of this moth were noticed to have completely defoliated *Parottia Jacquemontiana* bushes in the Chatri forest of the Chamba State, North-West Himalayas, in April-May 1896. Mr. J. H. Lace, noting this defoliation, secured some of the larvæ and bred out some moths. This pest must have several other food plants since Hampson gives its reported habitat as throughout India, Ceylon, and Burma; also Java.

Further observations are required on the following points:—

1. The length of time spent in the larval state by the April-May caterpillars.
2. Where the moth lays its eggs.
3. The number of generations passed through during the year.
4. The different food plants of the insect in different parts of the country.

---

[1] These notes on the life history were made by Mr. J. H. Lace, Conservator of Forests, at the time in charge of the Chamba Forest Division.

LEUCOMA DIAPHANA,

MOORE.

References:—Moore, Lep. Atk. p. 46; C. & S. no. 1051; Hmpsn. Faun. Br. Ind. i. 488, no. 1114.

Classification:—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Lymantriidæ.

Description.

Moth. Palpi slightly fuscous; frons orange, as is also the costa of the fore wing. Antennæ branched, the branches tinged with orange; the legs tinged with orange, wings diaphanous with a few hair-like scales.

In the Burmese specimen patches of scales remain at the upper and lower angles of cell of both wings. Expanse of wings 44 millim.

Hampson gives the habitat as Sikhim; Bernardmyo, Burma. To this must be now added Golaghat, Assam.

Life History, etc.

The larvæ of this insect were found accompanying the defoliators *Dasychira* sp. and *Lymantria grandis* in their great attack on the sál trees in the Goalpara district which commenced towards the end of August 1897. The *L. diaphana* larvæ were reported as very conspicuous during the first appearance of the other two, *i.e.*, during the August-September generation, but after that to have been scarce. They were again noted in the January-February attack which was that of the third generation of the above two pests. What generation of the *L. diaphana* larvæ these February ones represented does not appear to have been noted.

We thus see that larvæ of this insect are found in August-September and again in February. The dates of the pupal and moth stages still require to be observed Also (2) what becomes of the insects between February and the end of August, (3) the number of generations it has in the year, and (4) where the eggs of the various generations are laid.

AGROTIS YPSILON,

ROTT.

References:—Rott, Naturf. xi, p. 141. Noctua suffusa, Fabr. Mant. Ins. ii, p. 157; Moore Lep. Ceyl. iii, pl. 147, fig. 6; C. & S. no. 2001. Phalena idonea, Cram. Pap. Exot. iii, pl. 275 H. Bombyx spinula, Esp. Schmett, iii, pl. 63, figs. 6, 7. Hmpsn. Faun. Br. Ind. Moths, ii, p. 182, no. 1623. Stebbing, Injur. In. of Ind. For., p. 113, pl. vii. 2. a, b, c.[1]

Classification:—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Noctuidæ.

Description.

The *larva* of this moth is the so-called cut worm which for years has done an immense amount of damage to crops and plants in India, and is one of the worst pests at present known in the country.

The *eggs* are pale fulvous yellow in colour, nearly spherical in shape, the base being somewhat flattened.

The *larva* is a stout, naked, earth-coloured worm, varying from half an inch to two inches in length when full fed. In its early stages it is a semi-looper.

The *cocoon* is formed of fine particles of soil, firmly cemented together. On opening this the small *pupa* will be found inside. It is about half an inch in length and of a yellowish-red colour, the eyes and antennæ of the moth being distinctly prominent through the pupal case.

The moth is medium sized, the males having bipectinate antennæ, the branches being of moderate length. The insects are whitish brown, pale brown, or fuscous; palpi darker at sides; collar with dark line; abdomen whitish. The forewing suffused with brown, with double waved sub-basal ante and postmedial lines; the submarginal line dentate, with two black streaks on it below the apex and a marginal series of specks; the orbicular and reniform with dark centres and edges and

[1] See also Indian Forester, Vol. XXVII, pp. 62, 63, 243, 244 (1901).

with a black streak beyond the reniform; the claviform small and black; all these markings are much obscured in the darker specimens. Hind wing more or less suffused with fuscous brown with a dark marginal line. Expanse of wings 42—56 millim.

For diagrams of the larva and moth, see *Injurious Insects*, Pl. VIII, fig. 2, *a*, *b*, *c*.

Life History.

The eggs of this pest are laid in small batches and often in two or three layers covered sparsely with long scales from the abdomen of the female moth. These eggs are laid near the ground on twigs and branches of trees *away* from the food plant of the young larvæ which have therefore to seek their food plant when they hatch out. The eggs are also probably laid at times on the bare ground. The larva can be recognised by its colour and by the fact that it rolls itself up into a ball when disturbed. They are enormous feeders and devour and destroy young plants on a large scale. When full fed the caterpillar buries itself from 2 to 8 inches deep in the soil and there constructs a firm, irregular, oblong cell of earth, in which it pupates. The period spent in this state will probably vary in different parts of the country. The moths fly only in the dusk or at night, and except that they lay the eggs which give rise to the cut worms, do not themselves injure plants.

It is probable that this pest passes through at least two, if not more, generations in the year in the warmer parts of the country. In the North-West Provinces and Bengal the winter one has long been known. Young larvæ appear early in November and continue feeding until February when they pupate, this stage lasting rather less than a month. The moths appear on the wing in February and are to be found often in enormous numbers up to the middle of March.

A larva sent from Kurseong, Eastern Himalayas, in May changed into a pupa on the 17th, and a moth on the 28th of that month in the Indian Museum, Calcutta; whilst another from the Jessore district, Bengal, changed into a moth in September. It is these September moths which give rise to the November larvæ. It would thus appear that there may be three generations in part

of Bengal. This very important point requires further observation. From the above it will become evident that the different generations have generally, if not always, different host plants. In its cold weather generation in the plains the cut worm is known to feed on opium plants. Later on in the rainy season legumes and pulses replace the opium in the fields and the later generation adapts itself to the changed food plant and feeds upon these. In the case of the colder climate of the North-West Himalayas the number of generations will be reduced. The insects here pass the winter months probably as half-grown larvæ, hibernating under stems or logs or buried beneath the surface of the soil. In May they re-commence feeding, and they have been found at work in young deodar nurseries from the third week in May onwards through June into July, and probably pupate somewhere about the time the monsoon bursts over the hills. Mr. B. O. Coventry obtained pupæ at Gora Gali (Rawalpindi division) about the middle of July from which a moth emerged in the middle of October. These October moths, I think, will be found to lay eggs at once which hatch into the young larvæ, and these latter hibernate through the winter. If this proves to be correct, it will be found that in the colder climate of the hills, as in the colder portions of other parts of the world, *A. ypsilon* passes through but one generation in the year.

Localities from which reported.

Hampson gives this insect's habitat as "universally distributed all over the world with the exception of South America." It has been reported for many years as destructive to crops in various parts of India. In 1900 Mr. B. O. Coventry reported it as damaging young deodar seedlings in the Gora Gali nursery in the Rawalpindi division, Punjab, and I found larvæ feeding in the same way in 1901 (May to July) in nurseries of deodar in the Simla and Bashahr divisions of the same province.

Relations to the Forest.

Cut worms are serious pests to young vegetation of all kinds, being more especially destructive in dry seasons when they

often increase in immense numbers and do extensive damage.[1] The injury is committed by the larvæ gnawing off the plants close to the ground and feeding upon them. They are exceedingly wasteful in their methods since they will often gnaw off one or more you ng plants and then drag them a portion of the way to their burrows and, dropping them, attack fresh ones. The caterpillar's presence can often be detected by the presence on the surface of the soil of these cut-through and withering young seedlings, whilst others, or portions of their leaves and stems, are visible, protruding from the openings of the insect's burrows. The larvæ are nocturnal feeders and rest during the day in their burrows in the ground. In dull weather they may be found on the surface feeding by day as well as night.

Mr. B. O. Coventry thus describes the attack at Gora Gali :—

"During the summer months of 1900, it was noticed that a considerable number of deodar seedlings from seed shown in December 1899, had withered in the nurseries at Gora Gali in the Rawalpindi Division. It was found that the withered seedlings had been cut through close to the ground and the upper portion dragged down in to the soil."

At a nursery in the Kalela forest, Simla division, I found young deodar seedlings being attacked in a similar manner at the end of May, and the pest was also destroying seedlings in the forest. Later on, when with Mr. E. M Coventry, we ound the caterpillars in a nursery in the Nagkela reserve (Kotgarh, Simla division), and also eating seedlings put out or sown in patches in the forest. There can be no doubt that *Agrotis ypsilon* commits very considerable damage yearly amongst deodar seedlings, checking very appreciably the young growth in those areas in which it has obtained the upperhand.

Protection and Remedies.

There are several remedies which will be found effectual in getting rid of this pest from nurseries, etc :—

1. Before the young seedlings have come up place bundles of any succulent crop plant which may be growing in the neighbourhood (in America cabbage,

[1] Opium and other crops have been reported as suffering very heavily from the pest, occasionally scores of acres being as effectively swept clean as if a swarm of locusts had been over the area.

turnips and clover have been found most effective) at intervals on the seed beds, first sprinkling the bundles with Paris-green water. The young larvæ will feed on these and be killed off before the seedlings come up.

2. Crows, mynas, starlings, the cattle egret, and many other nesting birds all eat the grubs whenever they can find them, and they are particularly active in this respect in damp weather and after irrigation. Thus, whenever possible, the beds attacked by the pest should be flooded with water in the daetime. The water will fill the burrows and force out the insects, which, if birds are plentiful, will be picked up and eaten by them. If birds are not numerous hand-picking must be resorted to.

3. Another good method of checking the pest is to dust the plants over a few times in the evenings with a mixture of quicklime and ashes, or better still, add the arsenic compound Paris green to the two in the following proportion :—One ounce of Paris green with 1 ounce of unslaked lime and 3 lbs. of ashes. Powder the substances together very finely, put them into a calico bag and dust over the plants, loosening the soil around them first.

4. In nursery beds already attacked the surface of the soil should be carefully inspected, and all holes containing portions of leaves, stalks, etc., should be dug up and the larvæ at the bottom killed. This was the method resorted to at Gora Gali and gave good results.

It should be borne in mind, however, that our efforts should be in the direction of preventing the attack commencing or at any rate from becoming serious. With this object numbers 1 and 3 of the above remedies are recommended. The former would be well understood since the practice of poisoning jackals and porcupines is a very common one amongst the natives of India.

Points in the life history requiring further observation :—

I. In the warmer parts of India—

1. The number of generations passed through during the year and the length of time spent in the various stages of these generations.
2. The different food plants fed upon by the insects of these different generations.

II. In the colder climate of the North-West Himalayas and other cold areas in the country—

1. What becomes of the October moth? Does it lay eggs at once and die, and do these eggs hatch out the same year?
2. Does the insect hibernate through the winter in the soil as a half-grown larva?
3. Are the larvæ found feeding in May-July the offspring of the October moth?

[Other Noxious Grubs having the same habits.]

MELOLONTHA OR LACHNOSTERNA SP. ("WHITE GRUBS".)

Reference :—Stebbing, Inj. Ins. Ind. For., p. 35.

Classification:—Order, **COLEOPTERA**. Family, Scarabæidæ. Sub-Family, Melolonthini.

Description of Larva.

The *larva* is a large, heavy, yellowish-white, curved grub, the posterior segments of which are swollen up in a bag-shaped manner, being black in colour. The head is light brown, bearing two antennæ and a pair of long curved exceedingly powerful mandibles. Length 1½ to 2 inches. See Pl. VI, fig. 3.

Only the larva has at present been found.

Information at present known concerning the insect.

These grubs were discovered by the writer killing off deodar seedlings in July 1901 in the Taranda forest, Bashahr division, Punjâb. This forest had been cut over in 1898 and sowings were made in patches in February 1901, those made the previous year having failed. On inspecting the patches of young seedlings numbers were found lying dying or dead on the surface, cut through at their bases, whilst portions of others were found protruding from largish holes visible on the surface of the turned over soil. The following is a description of one patch which may be taken as typical of what was occurring in many of them, the state of affairs accounting probably for the failure of the young plants in previous years :—There were probably 25 seedlings originally in the patch. At the time of inspection five green uncut ones were all that remained standing in the soil. Most had been cut off either at the apex of the stalk just below the crown of needles or some way down the stalk but above the ground. These cut seedlings had been in some cases partially eaten or a few needles only had been consumed and then

the seedling left to wither, whilst fresh ones were attacked. Others had been dragged to the holes of the larvæ and entirely or partially dragged down the burrows. On digging down into the soil two of the above described large larvæ were discovered, they being responsible for the damage done. Had this patch been inspected two days later there would probably not have been a single seedling left in it. Several patches in the neighbourhood were in this latter condition.

I have not as yet been able to obtain the imago of this grub. The latter probably spends more than one year in this stage of its existence.

Further observations required.

Beyond the above notes apparently nothing further has been recorded on the subject of the life history of this pest. It and its method of attack were quite unknown to the forest guard whose beat I was in at the time and who accompanied me on my inspection. The length of time spent in the larval and pupal stages has still to be observed and specimens are required of the perfect beetle.

The remedies proposed under *Agrotis ypsilon* are applicable to this pest also. When hoeing up the soil before sowing the seed all such larvæ should be carefully killed and poisoned baits should be made use of when the young seedlings are beginning to appear above the soil.

In *Injurious Insects* under *L. impressa*, page 36, I mentioned the fact that although "white grubs" had not been up to then recorded as injuring seedlings in forest nurseries, etc., it was probable that they did so.

ELATERIDÆ (CLICK BEETLES).

Reference:—Stebbing. Inj. Ins. Ind. For., p. 40.

Classification:—Order, **COLEOPTERA**. Family, **Elateridæ**.

Description of Larvæ.

1. Larva light reddish-brown in colour with a horny, shiny, chitinous external covering, flat in section, with 3 pairs of prolegs on the first three segments of the body. Length $1\frac{1}{4}$ inches. This larva is shown in Pl. VI, fig. 4.

2. Larva brown in colour, hard, shining, with three pairs of prolegs on first three segments of body. Length $\frac{1}{2}$ an inch.

Only the larvæ of the above two insects have yet been obtained.

Information at present known concerning these insects.

1. One specimen of this "wire-worm," as the grubs of elater beetles are called, was discovered feeding at the roots of an English chestnut plant (*Castanea vesca*) in a small plantation near Kathian in the Jaunsar division, North-West Himalayas. It was noticed that several of the young plants, which had been raised from seed sent out from home, were dying or dead, and the cause was attributed to bad planting in several cases. One young plant I dug up had its roots rather badly gnawed, patches of bark having been peeled off. This wire-worm, a large specimen, was found at the roots and was responsible for the bad condition of the young plant. See Pl. VI, fig. 4.

2. The small wire-worms above described were found in the patches of deodar seedlings in the Taranda forest already alluded to as being destroyed by the large Melolonthid larvæ. The elaters were not very abundant and their attack was distinguishable from that of the cockchafer grubs, since they only cut the roots beneath the surface of the soil. The young plant was seen to be dead or dying without any apparent cause

until it was pulled up when it came away in the hand, its roots having been clean cut off. In this way these grubs move down lines of young plants in European nurseries, cutting through and feeding on the roots. They do not appear or feed upon the green portions of the plant above ground.

Further observations required.

No observations of the action or numbers of these insects in nurseries and young plantations, etc., have been recorded up to date. It will doubtless prove, however, that their probable presence should be taken into consideration on areas on which young plants are to be reared.

We have yet to discover how long these grubs spend in this condition, when they appear as the perfect beetle and what this insect is like.

Flooding the nursery beds and hand-picking are remedies to be recommended when these pests make their appearance.

ACRONYCTA ANÆDINA,[1]

BUTL.

References :—Butl. Trans. Ent. Soc. 1881, p. 19. Triæna maxima, Moore, P. Z. S. 1881, p. 333; C. & S. no. 1771. Hmpsn. Faun. Br. Ind. Moths, II, p. 240. no. 1813.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Noctuidæ.

Description.

The *larva* is a hairy caterpillar, blue-black in colour, with short tufts of blue-black hair on each segment of the body. In between these short tufts arise long pencil tufts of bright canary yellow hairs which stick out all round the insect, giving it a very woolly appearance.[2] See Pl. II, fig. 4, *a*.

The *pupa* is stout, dark chestnut coloured, and about 1⅛ inch in length.

The *moth* has a general greyish appearance and is thus described:—

♂. Whitish grey; palpi black at sides; thorax clothed with hair and scales; abdomen fuscous. Fore wing with some fuscous blotches on costa; a waved black fascia in interspace from base to below the orbicular; the antemedial double lines very faint; the orbicular and reniform black-edged, with a black streak between them, which is sometimes obsolete; the inner border of reniform double; the postmedial curved double lunulate line prominent, filled in with white and with a black streak, and sometimes a second one, crossing it; a marginal series of black spots. Hind wing fuscous white, with a postmedial line, the cilia whitish. Underside of both wings with a cell-spot and curved postmedial line.

---

[1] The notes on the life history of this insect are from observations made by Mr. B. B. Osmaston, F.C.H., who discovered it doing damage in the Jaunsar forests in 1899, and from others recorded by myself from specimens sent me by Mr. Osmaston and kept under observation.

[2] This description is made from a coloured drawing by Mr. Osmaston.

♀. Darker grey; fore wing with the streak between the stigmata and also the upper postmedial streak always present; hind wing darker fuscous; underside with the cell-spot to hind wing large. Expanse of wings :—♂ 54-60; ♀ 70 millim.

Pl. II, fig. 4, *b*, shows the pupa and, *c*, the moth of this insect.

Life History.

The eggs are laid some time during July, but it has not yet been reported where they are deposited.

The caterpillars are to be found on the trees they attack all through August, feeding upon the leaves of the food-plant. Towards the end of the month they spin a rough hairy cocoon and change into the pupal state inside it. They remain in this stage until the following July, the moths hatching out at the beginning of the month. Some pupæ collected in October and made over to me in December hatched out at Dehra Dun,[1] towards the latter part of May .This proves that in Jaunsar the insect has but one generation in the year, the earlier date at which my pupæ issued being accounted for by the fact that they were kept in a warmer place throughout the winter.

Localities from which reported.

The insect has been reported as doing considerable defoliating damage in the Jaunsar forests of the North-West Himalayas. Hampson gives the habitat of this moth as Japan, North-West Himalayas, Punjab, and Rangoon, so it has a wide distribution and has other food-plants besides the ones mentioned below.

Relations to the Forest.

A. anædina has proved itself a serious pest to the horse chestnut (*Æsculus indica*, Colebr.). It swarms all over the trees, entirely defoliating them in bad seasons. In 1889 by the end of August the trees were all leafless and the insect appeared to be equally abundant the following year. The hill tun tree

[1] Elevation 2,000 feet. They were kept through the winter in a room. They were brought down and made over to me at Chittagong in Eastern Bengal, and the weeks spent in this much warmer climate doubtless led to their issuing earlier.

(*Cedrela serrata*, Royle) is also attacked and to a less extent the walnut (*Juglans regia*, Linn.).

Protection and Remedies.

It has not been stated where the larvæ spin their rough cocoons, but it is probable that it is in exposed places, such as the bark of the main stem, branches, or on adjacent stems, etc. I would suggest, therefore, if the insect makes its appearance in nurseries of young walnut, that these hairy cocoons should be carefully searched for, collected, and destroyed. Since the insect spends some ten months of its life cycle in the Western Himalayas in this stage, this collection should not present any great difficulties.

The pest is doubtlessly kept in check to some extent by the parasitic flies with which numbers of the cocoons were infected. A determination of the species of these flies has not yet been effected.

Points in the life history requiring further observation :—

1. Where the rough hairy cocoons are spun by the larva before it changes into the pupal state.
2. The life history of the insect in Lower Burma. It will doubtless prove to have at least two generations in the year in the damp hot climate of that locality.
3. The food-plants of the insect in Burma.

PLECOPTERA REFLEXA,

GUEN.

References :—Guen. Noct. ii, p. 430; C. & S. no. 2312. Trigonodes gammoides, Wlk. Cat. xv, p. 1833. Poaphila simplex, Wlk. Cat. xv. p. 1840. Poaphila hamifera, Wlk. Cat. xxxiii, p. 992. Poaphila uniformis, Moore, Lep. Atk., p. 172, pl. 5, fig. 10; C. & S. no. 2313. Hamp. Faun. Brit. Ind. Moths, Vol. II, p. 519. no. 2549.

Classification :—Order, **LEPIDOPTERA**. Sub-Order, **HETEROCERA**. Family, **Noctuidæ**.

Description.

The *larva* is of the looper type, about an inch in length when full grown. It is green in colour with five white longitudinal lines running down its back. The head is paler green, or almost white. It is an active caterpillar, wriggling violently when touched.

The *pupa* is red and about ¾ inch in length. No cocoon is formed.

The *moth* is small and brownish and is thus described by Hampson :—

Palpi slight and reaching vertex of the head, the third joint minute; antennæ of male with long cilia and bristles; thorax and abdomen smoothly scaled; tibiæ slightly hairy and without spines. Fore wing with the apex nearly rectangular. Grey-brown in colour; the head and collar bright fulvous. Fore wing with obliquely waved antemedial line; a large reniform spot, often with black centre and with a rufous spot on the costa above it; an inwardly oblique waved postmedial line and sinuous submarginal line; a marginal series of minute dark specks. Hind wing fuscous brown; the outer area slightly darker. Underside greyish white; the outer area fuscous; male with the costal area of hind wing also fuscous. Wing expanse of 30 millim.

Pl. III, fig. 3, a, shows the larva, b, the ♂ and ♀ moths of this insect.

Life History.

The larva hatches out about the middle of April and spends some weeks feeding upon young sissu plants. It descends to the ground and changes into a pupa beneath the surface of the soil towards the end of June. A week is spent in this stage, the moths appearing at the end of June and on into July. These moths lay eggs, probably on the young shoots of the sissu plants, a second generation of larvæ appearing at the beginning of August. This is as far as observations of the life history have at present been carried and from them we see that there are at least two generations of the pest during the year.

The notes on the life history from 26th June onwards were made by Mr. B. O. Coventry in 1899. The writer found the young larvæ in the plantation in April 1901.

Localities from which reported.

This insect has been reported from Northern India, Poona and the Andamans. Mr. B. O. Coventry reported it from the Changa Manga Plantation near Lahore in 1899.

Relations to the Forest.

As far as is at present known, the larvæ confine themselves to defoliating young sissu growth. They do not apparently affect the older trees. With reference to the damage done Mr. B. O. Coventry wrote:—

"The larvæ do very considerable damage, as this year at least 100 acres stocked densely with one year old sissu coppice were denuded of every leaf . . . . This is the first year this plague has been noticed by me, although in the Changa Manga working-plan mention is made of larvæ having appeared in sissu coppice . . . ."

Protection and Remedies.

Until the full life history of the pest is known it is not possible to prescribe remedies. In this connection it is especially important to discover the stage in the life history in which the winter is passed through.

Points in life history requiring further observation:—

1. How and where the eggs of the first generation are deposited.

2. Time spent in the larval state by the caterpillars of the second generation.
3. Time spent in the pupal stage of the second generation.
4. Date of issuing of moths of the second generation.
5. Whether there are more than two generations of the insect during the year.
6. When and in which stage the insect passes through the winter. Is it as eggs in the axils or on the sides of the branches, or is it as larvæ or pupæ in the ground?

DIRADES THECLATA,

GUEN.

References:—Guen. Phal. ii, p. 36. Dirades adjutaria, Wlk. Cat. xxiii, p.849; C. &. S. no. 3049. Dirades binotata, Wlk. Cat. xxxxv, p. 1650; Moore, Lep. Ceyl. iii, p. 399, pl. 186, fig. 7; C. & S. no. 3051. Erosia vertecaria, Feld. Reis. Nov. pl. 128, fig. 7' Hmpsn. Faun. Br. Ind. Moths III, 132, no. 3065.

Classification:—Order, **LEPIDOPTERA.** Sub-Order, HETEROCERA. Family, Epiplemidæ.

Description.

The *larva* is a small, smoke-coloured grub, provided with 5 pairs of prolegs. Head yellow. It has a warty appearance, and is sparsely clothed with hair. Length when full grown half an inch.

Pupa yellow to yellow-brown, showing three clear marked abdominal rings on lower portion; ¼ inch in length.

A small *moth*; ground colour grey with yellowish markings.

♂. Antennæ and vertex of head whitish; head and thorax violaceous grey; abdomen ochreous, except at base. Fore wing violaceous grey; a large triangular patch outlined with double brown lines on the costa beyond the middle; a similar oval spot with darker centre on inner margin; a series of marginal fuscous lunules. Hind wing with the basal half violaceous grey, darkest at inner margin; the outer half pale ochreous brown, the two areas defined by a rufous and pale line; a series of marginal fuscous lunules.

♀. Abdomen and hind wing of the same violaceous grey as the ground colour.

Expanse of wings 22 millim.

Pl. V, fig. 4 *a*, *b*, *c*, shows the larva, pupa, and moth of this defoliator.

The notes on the life history of this pest were made by Mr. Gisborne-Smith in the teak forests of Damoh in the Central Provinces. He found the insect defoliating teak and *Adina cordifolia*, Hook.

Life History.

When first observed in the middle of August, these larvæ were about half grown. On the 28th or about the end of the month they become full fed and change into the pupal state. Only a week is spent in this stage, moths having been obtained on the 3rd and 4th September from larvæ which pupated on the 28th August. If a month is allowed for the larvæ to grow to their full size, we thus see that five weeks suffices for this summer generation. It is very probable that it will be found that there are several others in the year.

Localities from which reported.

The insect has a wide distribution. Hampson gives its habitat as W. Africa, throughout India, Ceylon, and Burma. These notes on its life history were made in the Central Provinces.

Relations to the Forest.

The larvæ defoliate the teak (*Tectona grandis*) tree in the Central Provinces. They were found feeding on the leaves in the Damoh District forests in company with the well-known teak defoliators *Hyblæa puera* and *Pyrausta machœralis.* The extent of the injury actually done by *D. theclata* requires further careful observation, but as a result of its attacks and those of the *Pyrausta* Mr. Gisborne-Smith stated that in certain areas at the end of August the teak trees were quite brown, the whole of the foliage having been skeletonised and killed by these two caterpillars. *D. theclata* was also found feeding upon *Adina cordifolia* and "paraspipal" trees.

Protection and Remedies.

The prescription of remedies for these defoliating larvæ is difficult and impossible until their full life histories are known. Mixed forest is, however, generally found to escape these heavy defoliating attacks better than a forest consisting entirely of the one species of tree attacked, and it is advisable to bear this point in mind when laying out plantations and coppice areas.

Points in the life history requiring further observations :—

1. Where the eggs are laid.
2. Time spent in the larval stage by the August caterpillar.
3. What becomes of the September moths.
4. The number of generations in the year.
5. Where the insect passes the cold weather and in which stage of its metamorphosis.

BOARMIA SELENARIA,

HÜBN.

References :—Hübn. Samml. Eur. Schmett., Geom. fig 163. Boarmia dianaria, Hübn. Samml. Eur. Schmstt. Geom. fig. 483. Boarmia reciprocaria, Wlk. Cat. xxi, p. 336. Boarmia imparata. Wlk. Cat. xxi, p. 372; C. & S. no. 3344. Boarmia promptaria, Wlk. Cat. xxi, p. 379; C. & S. no. 3333. Opthalmodes cretacea, Butl. A. M. N. H. (5) iv, p. 373. Hmpsn. Faun. Br. Ind. Moths, III, p. 264. no. 3403.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Geometridæ.

Description.

Larva.—When young the larva is pale sap-green in colour with a yellow head and a yellow stripe running down each side of the body. There are two dark-coloured spots on the last but one abdominal segment, and another pair on the sixth segment. The caterpillar is of the "looper" type, having three pairs of jointed legs on the first three segments, one pair of anal claspers and only one other pair of clasper legs placed on the ninth segment; the larva moves forward by looping up its b dy in the manner peculiar to the caterpillars of this family. As the insect grows older a dark purple line becomes visible down the dorsal surface, the spots on the last segment but one and on the sixth segment being still present. The sides, the last abdominal segment, and the ventral surface are still greenish-yellow, but in addition the sides have a row of purple spots, becoming almost a continuous line, running down them. The head is reddish yellow, squarish in outline when seen from the front. The last pair of claspers are very large. When full grown the caterpillar may have the above colouring or the insect may be coloured an exact imitation of a sál twig, the ground colour being a reddish-brown with patches of purple-black and a purple-black line down its dorsal surface; a series of purple spots down the sides, slightly dorsally, and a whitish-yellow line down the

ventral surface. Head reddish and square in outline. Length $2\frac{1}{2}$ to $2\frac{3}{4}$ inches. Mature caterpillars with this colouring were more common than the green variety.

The *pupa* is stout, reddish-brown in colour, shining and hairless. Length $\frac{7}{8}$ths inch. The pupal stage is passed in the earth, the larva descending the tree and burying itself amongst the leaves and soil at the foot. No cocoon is formed.

The *moth* is greyish in general colouring with brown markings more or less speckled over the wings. Lower edges of wings slightly scalloped. Hampson describes it as follows :—

" Antennæ of male minutely serrate and fasciculate ; hind tibiæ slightly dilated. Ground-colour whitish, grey or pale fuscous, irrorated with dark brown ; abdomen with paired dark dorsal specks. Fore wing with indistinct curved and slightly waved median line, becoming straight and antemedial on hind wing ; both wings with grey centred lunule at end of cell ; a prominent crenulate postmedial line ; traces of a sinuous sub-marginal pale line ; a marginal series of dark specks. Underside pale, with large black cell spots ; fore wing with a diffused sub-apical black patch. Expanse of wings : ♂ 45—50, ♀ 45—56 millim."

Life History.

The eggs are probably laid by the moths on the twigs of the trees. Towards the end of April, when first found in the Dun forests by Mr. Milward and the writer, the larvæ were of all sizes, from a few days old to nearly or quite mature. From the defoliated state of the trees the caterpillars had evidently been at work for some time. They probably first appear some time during March just as the sál trees, upon which they chiefly feed, are bursting into new leaves. The larvæ feed voraciously, devouring both new and old leaves, flowers, and green leaf stalks, the older ones even gnawing down the new green shoots of the year. Thus when a band of these caterpillars have swarmed over a tree, they do not leave it until practically all green growth has been stripped from it. The colouring of the dark variety of larva is an exact imitation of a sál twig, but they do not appear to make any use of the protection thus afforded them. The sap-green variety is also almost invisible at a short distance

amongst the leaves and flowers. Both, however, are to be found indiscriminately all over the tree. When they have stripped a tree, they drop on to the nearest unattacked one or on to the ground, letting themselves down by means of silken threads, and march off to fresh trees. The caterpillars become full-fed at the end of April, and they then drop down to the ground by means of their silken threads and pupate in the earth at the foot of the tree, no cocoon being constructed.

A number of larvæ were taken by the writer into Dehra Dun, and the first seventeen of these transformed into the pupal state on May 5th, and remained in this stage until the 16th of the month.[1]

The first twelve imagos appeared on the 16th May followed by eleven more on the 17th, and others within the next few days: the moths emerging in approximately the same order in which the larvæ transformed into pupæ. An attempt made to obtain eggs was not successful, the moths kept for this purpose being attacked by ants and killed. This is as far as the life history has been taken at present. It is probable, however, since the insect makes its first appearance in the spring and attacks the spring growth, that *B. selenaria* is at least double brooded, a second generation of larvæ appearing when the summer flush of leaves comes on to the sál trees in August. Larvæ were reported to have appeared in various parts of the forest in this latter month, but no specimens were kept or definite results observed. The question as to the number of generations is however important.

Localities from which reported.

Hampson gives the following distribution of this pest:—

Europe, Amur, Japan, China, North-West Himalayas, Nepal, Khasis, Congo, South Africa.

The insect has therefore a very wide distribution and is consequently the more to be feared since its powers of adaptability to varied environments must be considerable, as also its powers of rapid multiplication when conditions are favourable.

[1] Owing to my absence from head-quarters on tour the moths were kindly bred out for me by Forest Ranger Birbal, Curator, Imperial Forest School. The dates in question are those noted by him.

In the Dehra Dun forests the present reported range is from the Saharanpur-Chakrata Road on the west to the eastward boundary of the forest on the Ganges River, only the northern slopes of the Siwaliks being noted as affected. Within this area the intensity of the attack in 1901 varied, being much more severe in some parts than in others.

No reports from the officers in charge of adjacent sál areas have been received with reference to this pest.

Relations to the Forest.

When the caterpillars appear in large numbers in the forest the damage they are capable of doing is very considerable. When full grown the larva is of considerable size and during its whole life it is apparently a voracious feeder, attacking and entirely stripping the trees of all green growth, as also of the flowers. In the middle of April numerous large sál trees were to be seen entirely defoliated having the appearance of deciduous trees in winter, whilst others were rapidly becoming leafless under the attacks of the swarming larvæ. The annual increment put on by these trees is much less in years of serious defoliation, since growth ceases until the summer flush of leaves makes its appearance in August. If, however, the damage done to the mature trees is great, that suffered by the young growth is much greater. Young saplings, entirely stripped of all green growth in the spring, were found in September standing black and gaunt in the forest, still alive, but having been quite unable to recover sufficiently from the spring attack to be able to put out any summer crop of leaves. Thus heavy defoliation by this pest in the spring causes a cessation of all growth in young saplings during the year. If the pest appeared in similar numbers in successive years, it is evident that the young growth in the forest would rapidly deteriorate and much of it would succumb.

What rendered the attack even more serious in the Dun forests in 1901 was the fact that *B. selenaria* appeared in several of the areas already attacked by the scale insect, *Monophlebus Stebbingii*, and both insects were often to be seen in large numbers on the same trees, both young and old, the looper

stripping the leaves and green parts off the tree, the scale tapping the branches and taking a heavy toll of sap.

Protection and Remedies.

Until the life history of this pest has been worked out, it is not possible to say what remedies may be practicable over large extents of forest. We have yet to ascertain what insect and fungoid parasites attack the pest. Mr. Milward noticed that the caterpillars were practically absent from an area which had been burnt over in the preceding hot weather. The old trees had suffered to a certain extent from the fire and most of the young growth had been killed. It may have been that the foliage of the trees proved acrid and distasteful to the larvæ, or the insect may have been in its pupal stage in the soil and leaves on the ground and thus got roasted and killed off.

If there is a second generation, it may perhaps not appear in areas that were devastated by the first one. The moths on coming out about the middle of May will not lay their eggs in areas where the food-supply, owing to the heavy attack made by the April larvæ is likely to be deficient for their offspring. In searching for these latter therefore, it will be necessary to inspect adjacent areas of sál untouched in the spring in addition to those which suffered from the April larvæ.

Points in the life history requiring further observation:—

1. Where the eggs are laid—
    (1) by the moth of the April generation,
    (2) by the moth of the subsequent generation, if there is one.

    An examination of the branches when the moths are on the wing should show this.
2. Whether there is a second generation, and, if so, the dates of appearance of the various stages of egg, larva, pupa, and imago.
3. In which stage the insect passes the winter, and where.
4. What insect or fungus parasites attack it, and their methods of procedure.

TRACHYLEPIDEA FRUCTICASIELLA,

RAG.

Reference:—Rag. Ann. Soc. Ent. Fr. 1887, p. 260.

Classification:—Order, **LEPIDOPTERA**. Sub-Order, HETEROCERA. Family, **Pyralidæ.**

Description.

The *larva* is a smoky grey above, pale yellowish white beneath, the segments of the body being covered with scattered bristly hairs. Length 1 to 1¼ inches. See Pl. V, fig. 5*a*.

The *moth* is small, grey brown in colour, the antennæ in the male being simple, with a tuft on the basal joint. Fore wing with the median area darker and clothed with rough erect scales, especially towards the costa; indistinct ante- and post-medial lines of raised dark scales, the former oblique and obsolete towards costa, the latter oblique and angled inwards on vein 5; a very indistinct discocellular spot; a marginal series of specks. Hind wing dull brownish yellow. Expanse of wings ♂ 20—27; ♀ 29—34 millim. Pl. V, fig. 5 *b*, shows the moth of this pest.

Life History.

The writer found the caterpillar of this moth tunnelling in *Cassia Fistula*, Linn., pods at the beginning of February. The grub was at the time nearly full-grown. It changes into the pupal state towards the end of the month by which time the pods are ripe. The moth appears at the beginning of May,[1] *C. Fistula* flowers in April, and it is probable that the moths lay their eggs near or on the young forming fruit, and the larvæ on hatching out tunnel into the pod and increase in size with the growth of the bean. More than one egg is laid in this position by the moth since several larvæ have been found in

---

[1] The pod taken by myself on the 1st February and brought into Dehra was made over to Babu Birbal, Curator of the Imperial Forest School, in April, and he bred out moths from it on the 3rd May.

each pod. Thus it would appear that some nine to ten months of the life of the insect are spent in the larval stage.

Localities from where reported.

The insect was found attacking the pods of a tree at Beribara in the Saharanpur Division, North-West Provinces.

Hampson gives Beyrout, Egypt, and the Punjab as the recorded distribution of the insect.

Relations to the Forest.

The larvæ bore up and down the long pendulous sausage-like pods which are from 1-1½ ft. long when fully grown. Only one hole is apparently made through each partition separating the seeds from one another. The seeds are tunnelled through and the pod turns black and rots. As these latter have a medicinal value, the attacks of this pest are of some importance. This insect should be distinguished from a smaller moth, *Cryptophlebia carpophaga*, Wlsm., a Tineid whose larva also attacks these pods.

Points in the life history requiring further observation:—

1. The chief point is to ascertain definitely where the eggs are laid. This will give the clue as to whether it is possible to prescribe any satisfactory method of checking the attacks of this insect in cases when it would pay to institute them.
2. When and where the larvæ first make their appearance.
3. What becomes of the May moth.
4. Occasionally the *C. Fistula* flowers a second time in the autumn. Where this occurs, is this larva found attacking the resulting pods?

EUZOPHERA CEDRELLA,[1]

HMPSN.

Reference :—Hampson in litt.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Pyralidæ.

Description.

A small *moth* with palpi up-turned and reaching vertex of head. Head, thorax, and body greyish. Fore wing long, narrow, with apex somewhat rounded; dark grey to blackish in colour; a series of black spots near outer margin and an erect, jagged, white antemedial band. Under wings smoky-grey with a dark line and fringe on lower margin. Expanse of wings about 15 millim. See Pl. II, fig. 6*a*.

Localities from which reported.

As far as at present discovered this insect's habitat is the coniferous forests of the Jaunsar, Teri-Garhwal and Simla Hills in which area its larva attacks the cones of the deodar and spruce trees.

---

[1] The identifications of this and various other moths mentioned in these notes have been very kindly determined or checked for me by Sir George Hampson, *Bart.*, to whom my very best thanks are due. *E. cedrella* is a recently discovered species.

PHYCITA ABIETELLA,

SCHIFF.

References:—Schiff. Wien. Verz. p. 138. Tinea decuriella, Hübn. Samml. eur Schmett, fig. 74. Tinea sylvestrella, Ratz. Fortz. 1, p. 244, pl. 15, fig. 1. Pinipestis abietivorella, Grote, Bull. U. S. Geol. Suvr. iv, p. 701. Hamps. Faun. of Brit. Ind. Moths, iv, p. 91, no. 4387.

Classification:—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Pyralidæ.

Description.

This is a small *moth*; the upper wings greyish in colour with blackish-brown markings; lower wing a uniform dark grey. It is thus described in the Fauna of British India:—

"Head, thorax, and abdomen grey and fuscous. Fore wings grey, thickly irrorated and suffused with fuscous; a dark brown patch on base of inner area; a dark antemedial line with a grey band on its inner edge, angled outwards below costa and inwards on median nervure and vein 1; a larger brown patch inside the grey band, less prominent towards costa: a prominent quadrate discocellular grey spot with a brown patch below it; a grey-edged dark postmedial line angled inwards at vein 6, then bent outwards and minutely dentate, some brown suffusion beyond the line; a prominent marginal series of dark specks. Hind wings semi-hyaline with a brown tinge; the cilia white, with a brown line at base.

"The prominence of the grey and fuscous markings of fore wings varies considerably. Expanse of wings 22—34 millim." (See Pl. II, fig. 7*a*.)

Localities from which reported.

The insect's range as at present discovered is the forests situated on the Jaunsar-Barwar and Teri-Garhwal hills to as far west as Simla. The writer has bred out specimens from cones obtained from various parts of this area.

It has a widespread distribution since the species has also been reported from the United States, Europe, and Japan.

Description of larvæ.

The two moths above described have both been bred out of deodar and spruce cones. *P. abietella* has in addition been reared from infested silver fir and blue pine cones. It follows that there are at least two, if not more, different species of larvæ attacking these cones, and I have found this to be the case with all the cones although the *E. cedrella* moth has only been obtained from the deodar and spruce. I have not as yet been able to settle which *larva* produces the individual moths in question, and the larvæ are therefore described here together.

Some immature larvæ about a fourth grown were about ¼ inch long, dirty yellow smoke-coloured with a black head. (Taken from deodar cones on 22nd May.)

Mature or nearly mature larvæ :—

1. A dirty yellow grey in colour with a tinge of green, smooth, and shining ; head black. Length 1¼ inches. Some similar forms had scattered bristles over their bodies. (From blue pine, spruce, deodar, and silver fir in July.) See Pl. II, fig. 7*c*.
2. Light reddish earth-coloured, light green on ventral surface ; first abdominal segment yellow. Head blackish yellow. Length 1 inch. (From spruce in July.)
3. Similar to No. 2 but more pink in colour, with black head and a black band or collar on upper surface of first abdominal segment. (From spruce in July.)
4. Purplish on dorsal surface becoming a pale greenish yellow on ventral surface. Head black. Length 1½ inches. (In deodar cones from Jaunsar in September.)

Pl. II, fig. 6 *b*, *d*, show a larva and pupa taken from a deodar cone and thought to be the larva and pupa of *E. cedrella*. I consider this, however, doubtful since at the time it was not known that there was more than one species of larva attacking the cones.

Life History.

As far as is at present known the life history of both these insects is approximately the same. The *eggs* have not yet been discovered. It is possible that both the insects deposit them either on the twigs near the young female flowers or, in the case of the deodar, in the young flowers themselves as they are open in October. The eggs should be looked for between September and November.

The larvæ make their appearance in the spring, but the first part of their life history is unknown. The attack is first noticeable owing to the small holes surrounded by resin which make their appearance on the lower half of the cones—see Pl. II, fig. 6*e*. I have seen these as early as May in the case of the deodar cones; in June in spruce, blue pine, and silver fir cones. On cutting up such diseased cones the larvæ will be found tunnelling up or down them (depending upon the point of entrance), the seeds being often pierced through and eaten; the grubs will be found wallowing in the large amount of turpentine exuded by the cone through the wounds thus made. The long cylindrical spruce and blue pine cones become contorted into fantastic shapes under this attack.

Towards the end of July and first part of August most of the larvæ appear to be full fed (though some are to be found on into September) and change into the pupal state. By this time the cone will have become so diseased that it will have fallen to the ground and some of the larvæ (if not all the species) leave it and enter the ground and pupate there.

I think it probable that at least one of these larvæ migrates from cone to cone. I have usually found more than one grub in a cone though there may not be more than one of any individual species present, the moths having only laid one egg near or on each flower. The mature insects appear on the wing between September and October. Specimens I bred out at Dehra Dun[1] issued as follows: on 12th September two moths from silver fir; 19th September moths from blue pine and on

[1] The warmer climate of Dehra, of course, affected the period of issuing of the moths.

28th from spruce; on 4th October from deodar. All these were *P. abietella*. *E. cedrella* was obtained from spruce and deodar in October.

Relations to the Forest.

Our knowledge is at present insufficient to enable us to say which of these two pests is the most aggressive, or whether there may not be others at work with them. The effect of their attacks is, however, most injurious since in bad years the majority of the seed crops are entirely lost. This was the case with the deodar crop in 1898, nearly the whole of which, according to Mr. Ribbentrop,[1] was lost from the trees round Simla, whilst Mr. Osmaston reported the destruction of cones the same year in the Jaunsar forests. The attack does not seem to have been noticed (or at any rate reported) on the spruce, silver fir, and blue pine during the year. The insects have been more or less plentiful in deodar cones during the succeeding years, and last year (1901) they were found not only abundant in deodar but also in spruce, silver fir, and blue pine. It is probable that they caused the loss of the majority of the seed of these four trees during 1901 in the portions of the Simla and Bashahr divisions visited by the writer.

Protection and Remedies.

Until the full life history of these insects is known it is too soon to even attempt to suggest here what remedies, if any are possible, can be recommended for trial in the case of such pests.

Points in the life history requiring further observation :—

1. Where the eggs are laid. The discovery of this point is most important.
2. When the larvæ first hatch out, and where they spend the first stages of their life histories.
3. The number of different species of larvæ attacking the cones, and which species of cone they are most common in.
4. The length of the various pupal stages.

[1] *Vide* "Notes on the Deodar," *Indian Forester*, Vol. XXV, Appendix.

5. The length of time during which the moths are to be seen on the wing in the forest.
6. The stage in which the insects pass through the winter. Is it the egg stage?
7. The description of the larva of *E. cedrella* and that of *P. abietella*.

NOTE.—The above observations are required for each tree. With reference to No. 3, I recommend that cones be cut up monthly from Apri onwards, and that the larvæ taken from each be carefully examined, described and then put into formalin, which will prevent their colours going, and sent to me to Dehra Dun.

To ascertain No. 7 I recommend the following: Species of each of the different kinds of larvæ should be put on to uninfected cones on convenient trees where they can be constantly watched—one on each cone, a description of the larva in each case being first made. Each cone should be then tied up in a muslin bag until about the end of July. It should then be cut off and placed in a small wooden box with a layer of moist earth at the bottom of it and the moth bred out. In this way it should be possible to definitely ascertain not only which are the larvæ belonging respectively to *E. cedrella* and *P. abietella*, and whether they have any other companions, but also which is the greater pest of the two.

MACALLA MONCUSALIS,[1]

WLK.

References :—Wlk. Cat. xvi, p. 252; C. & S. no. 2942. Allata penicillata, Wlk. Cat. xxvii, p. 111; C. & S. no. 4640. Orthaga obscura, Moore, Lep. Atk., p. 201; C. & S. no. 4490. Pseudolacastra inimica, Snell, Trans. Ent. Soc. 1890, p. 566 (nec. Butl.) Hmpsn. Faun. Br. Ind. Moths, IV, 113, no. 4440.

Classification :—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Pyralidæ.

Description.

The *larva* is said to be small, of a dull cream colour and more or less transparent, much resembling that of *Tetridia caletoralis*, but smaller. A cocoon of loose white silk is spun by the larva before it changes to the pupal state.

The *moth* is small dark fuscous in colour and with up-turned palpi. Fore wing with apex rectangular and with traces of dentate antemedial line angled in the cell; the fan of scales in end of cell grey; a black discocellular speck; an obscure dentate postmedial line highly angled at vein 4 and with diffused grey on its outer edge. Underside of hind wing with traces of discocellular lunule and minutely dentate postmedial line excurved from vein 6 to 2, ♀ paler and more olive-green. Expanse of wings ♂ 26, ♀ 26-32 millim.

Localities from which reported.

Hampson gives the reported range of this insect as Sikkim, Bhutan, Nagas, and Manipur. The sál forests in the Ganjam District, Madras, are now added to the above.

Life History.

The larvæ are full fed in the latter part of June. In the case of specimens kept in a box, the larvæ spun a cocoon of

[1] This insect and the Pyralid moth *Tetridia caletoralis*, Wlk., were sent to me from the Ganjam District, Madras, by Mr. C. E. C. Fischer, Deputy Conservator of Forests. The notes on the life history, etc., of the species are from his pen. The identifications were kindly made by Sir George Hampson, *Bart*.

silk to the sides of the box and pupated in this. It is probable that this cocoon is spun on the leaves or twigs of the food plant in the forest. The insect spent 15 days in the pupal condition, a larva which changed into this state on 24th June issuing as a moth on July 8th.

The time spent in the larval stage and the number of generations of the moth in the year have yet to be ascertained.

Relations to the Forest.

These larvæ were found in company with those of the Pyralid moth *Tetridia caletoralis* defoliating young sál saplings from 3 to 5 feet high in the Kriamba Reserve of the Ganjam District in Madras. The damage done, as far as it has at present been observed, has not been heavy.

Protection and Remedies.

In nurseries and plantations larvæ of this description when they become numerous, and therefore dangerous, are best treated by spraying the young plants with the arsenical compound Paris green. The method of doing this has been described elsewhere. Dusting the plants over with a mixture of Paris green, unslaked lime, and ashes, as described for the locust *Tryxalis nasuta*, might be tried as an alternative method.

Points in the Life History requiring further observation—

1. Where the eggs are laid.
2. Length of time passed in the larval stage by the June caterpillars.
3. What becomes of the July moths?
4. The number of generations in the year.
5. What becomes of the insect in the winter?
6. Does it feed on old as well as young trees?

TETRIDIA CALETORALIS,

WLK.

References:—Wlk. Cat. xviii, p. 651; C. & S. no. 4233. Botys vinacealis, Moore, P. Z. S. 1877, p. 619; C. & S. no. 4236. Polythlipta albieandalis, Snell. Tijd. v. Ent. xxiii, p. 221, nnd xxvi, pl. 8, figs. 7, 7a, b, c. Hmpsn. Faun. Br. Ind. Moths IV, 395, no. 5138.

Classification:—Order, **LEPIDOPTERA**. Sub-Order, HEEROOERA Family, Pyralidæ.

Description.

The *larvæ* are described as being of a dirty dull cream colour more or less transparent. Length 1 to 1⅛ inches. It has been noticed that before changing into the pupal stage they become light claret coloured. The caterpillar spins together a portion of a leaf with silk, forming a rough cocoon before changing into the pupal state.

The *pupa* is ochreous brown, shining, and just under ¾ inch in length. ,

A small *moth* red-brown in colour with a vinous tinge; antennæ of male minutely ciliated and considerably longer than fore wing, those of female about same length as fore wing; palpi porrect triangularly scaled and white below; fore tibiæ and tarsi marked with white; mid tibiæ and tarsi white; the tibial fringe of hair fulvous; abdomen with a white streak on anal tuft. Fore wing with waved antemedial black line; a waved discocellular line; both wings with a minutely crenulated postmedial line, nearly straight from costa to vein 3, then retracted to below end of cell, and on hind wing terminating at anal angle; a marginal series of black specks. ♀ pale ochreous, rufous. Fore wing with the costa tinged with fuscous; the margin and cilia of both wings fuscous; the legs not marked with white. Expanse of wings 34 millim. See Pl. v, fig. 6 *a*, *b*.

Localities from which reported.

Hampson gives the range as Sikkim, Khasis, Sibsagar, Ceylon, Burma, Andamans, Borneo, Celebes. Ganjam District, Madras, is now here added.

Life History.[1]

The larvæ are full fed at the end of the third week in June and pupate by spinning themselves up in a portion of a leaf of the food plant by means of a white silk. Within the covering they turn into pupæ. About 15 days is spent in this stage, larvæ which pupated on 23rd June issuing as moths on the 7th July. This is at present all that has been reported on the life history. We still require to know the length of time the June larvæ spend feeding and the number of generations of the insect there are in the year.

Relations to the Forest.

The larvæ of this insect defoliate the sál (*Shorea robusta*) in Madras. They were found feeding on sál seedlings from 3 to 5 feet high in the Kriamba Reserve of the Ganjam District. The damage done, as at present observed, has not been very heavy. It is found feeding in company with *Macalla moncusalis*, Wlk.

Points in the life history requiring further observations:—

1. Where are the eggs laid? Is it on the branches of the sál trees?
2. Length of time passed in the larval stage by the June caterpillars.
3. What becomes of the July moths?
4. The number of generations in the year.
5. What becomes of the insect in the winter?
6. Does it feed on old as well as young trees?

[1] The notes on the life history of this insect, together with specimens, were sent to me by Mr. C. Fischer, Deputy Conservator of Forests, Ganjam District, Madras.

CRYPTOPHLEBIA CARPOPHAGA,

WLSM.

Reference:—Wlsm. Indian Mus. Not. iv. 3, 106.
Classification:—Order, **LEPIDOPTERA**, Sub-Order, **HETEROCERA**. Family, **Tortricidæ**. Sub-Family, **Olethrentinæ**.

Description.

The *larva* is about five-eighths of an inch in length, but though it has been figured, no description of it as yet appears to have been made.[1] See Pl. V, fig. 7, *a*.

Moth.—Antennæ pale tawny. Palpi tawny, paler on their inner sides, shaded with fuscous externally. Head tawny, shaded with reddish fuscous above. Thorax blackish. Fore wings tawny with a blackish patch towards the centre of their lower surfaces and a small crescent-shaped mark on the outside of these. Outer edges also blackish. Hind wings brownish fuscous. Abdomen greyish with a slight ochreous tinge, a black tuft above the anal segments. Hind legs bone-grey with the tufts on the tibiæ strongly irridescent dark purplish on the upper sides.

In the ♀ the tufts of hair present, in the ♂ are absent. In the hind wings little sign of the pouch-like fold in the neighbourhood of the abdominal margin can be seen. The fore wings are reddish-tawny. It will probably be found that there is some variation in the ground colour of these moths. Expanse of wings ♂ 18 millim, ♀ 17 millim. Pl. V, fig. 7, shows, *b*, the pupal case protruding from the bean and *c*, *d*, the ♂ and ♀ moths.

Life History.

Little is known about this insect. The larvæ were found in the cold weather feeding in pods of *Cassia Fistula*, *L.* and *C. occidentalis*, *L.* They changed into the pupal state inside the pods.

---

[1] This moth was bred from *C.* Fistula pods in the Museum in Calcutta in 1894, and from *C. occidentolis* pods also from Calcutta in 1895. The insect was named by Lord Walsingham, both genus and species proving new to science.

These pupæ appear to cut their way through the skin of the dry and ripe pod and protrude half their length or more from the pod before the moth bursts the skin and escapes. Moths issued at the beginning of January, and it is probable that the dates on which they issue in different parts of the country depend to a certain extent on the time of flowering and fruiting of the trees it attacks. Its life history is likely to be somewhat similar to that of *Trachylepidea fructicasiella*, which also attacks the pods of *C. Fistula*.

Points in the life history requiring further observation:—

1. When the eggs are laid.
2. How long the larva spends tunnelling in the pods?
3. What becomes of the January moths?
4. The number of generations in the year.

CUNNINGHAM ... 1- FEB 1903

YPSOLOPHUS SP.

Reference:—Provisionally determined as such by Mr. M. Durrant.

Classification:—Order, LEPIDOPTERA. Sub-Order, HETEROCERA. Family, Plutellidæ. Sub-family, Gelechinæ.

Description.

Larva.—When full grown the larvæ are about half an inch in length, pale lemon yellow in colour and translucent. Head light brown. Body tapers towards posterior segments, the last two of latter having a dark coloured spot on their dorsal surface. A dorsal median brown line runs down the 8 anterior segments of the body. The colouring is the same in the young larvæ, but the head is black and well developed, standing out on either side of the body, which is not the case in the full grown one where it is of the same width as the body.

Pupa.—Anterior end black, abdominal segments yellowish-brown. Length slightly under half an inch. The pupa is contained within a loose net-work of fine silk which the larva spins across the inside of a leaf before changing to the pupal state.

Moth.—Small, with narrow wings. Fore wings a pale yellowish-brown, fringed on their outer extremities. Under wings grey, their lower edges heavily fringed, a buff-coloured line running between the outer edge of wing and the fringe. Antennæ filiform.

Plate III, fig. 4, shows the larva, pupa (which is attached to the centre of a Sissu leaf), and moth of this small pest.

Life History.

The larvæ were found defoliating Sissu leaves on the 18th April and were then of all sizes, some being about full grown. My attention was drawn to the attack by the fact that the lower branches of the large Sissu trees were festooned with long thin strands of silky web which had caught and enclosed masses

of the dead flowers of the tree. The ends of the whippy branches were often entirely enclosed by this silk, and the leaves were then either partially or entirely defoliated. An examination of some of these branches showed numbers of small larvæ feeding upon the leaves. In some cases, the larvæ were full fed and were then to be found in twos and threes, either between two leaves bound together by silk threads or amongst the dead and shrivelled up calyces of the inflorescences which were interwoven into the silken meshes. The larvæ are partially gregarious since they bind up two or three leaves together, fastening them so as to form a small tent, the upper surfaces of the leaves being outermost. Within this small shelter several larvæ may be found living and feeding together. They usually eat the underside of the leaf leaving the upper epidermis intact; this shrivels up into a brown, wrinkled, papery substance which remains bound up in the webs. When the larvæ have finished the leaf tissue within their small tent, they vacate it and proceed to fresh leaves. In the course of these wanderings enormous quantities of silk are spun by the grubs, festooning the trees more especially in the lower halves of their crowns, though at times the silk could be seen covering the summits of the trees as well. The Bari Doab Canal, which runs through the Changa Manga plantation, presented a remarkable sight. Great silken streamers, 20 to 30 feet in length, hung across the canal from the branches of the trees on either side. The ends of the branches themselves were woven up in a (in many cases) complete net of silken strands which entirely enveloped all the branchlets and leaves. Garlands went from branch to branch, and tree was festooned to tree along the banks in a remarkable manner. The almost horizontal rays of a setting sun gave the scene a most bizarre effect and showed, as no other play of light could have done, the seriousness of the attack. When the smallness of the caterpillar is taken into consideration it becomes evident that millions and millions must have been present to have produced this enormous amount of silk.

The larvæ change into the pupal state about the end of April, spinning a flimsy silken net-work across the inside of a leaf or two thereby drawing the edges together. Within this

they change into the pupa. The pupal stage lasts about ten days, moths of larvæ taken to Dehra Dun issuing about the 13th May.

This much of the life history has been studied up to the present. It is almost certain that there will be at least one more generation, if not several, of the insect during the remainder of the year since the first generation is completed by the middle of May, and this point requires further careful observation.

Locality from which the insect has been reported.

This insect was found by the writer seriously defoliating the Sissu (*Dalbergia Sissoo*) in the Changa Manga plantation near Lahore in April 1901.

Relations to the Forest.

The damage is done by the caterpillars who completely or partially defoliate the Sissu trees. They appear to prefer the older, or it would be more correct to say, the taller trees, and were by no means numerous in small coppice. They eat the whole of the leaf, or the greater portion of it, leaving generally intact the upper epidermis. The Sissu was the chief tree attacked, though here and there I saw the webs and found the larvæ on the mulberry and the *Acacia modesta*. The attack had by no means ended when I left the plantation, but even then I estimated that 50 per cent., and probably more, of the trees were suffering from the caterpillar. Compartments here and there had, however, entirely escaped up to the date of my departure. I first noticed and examined it in compartments 72 and 73. Amongst other it was also more or less severe in compartments 1 and 8 in Block I, 9, 51, 52, 54, 86, 87, 89, and 90.

Protection and Remedies.

Until more has been ascertained about its life history it cannot be said with any certainty that a feasible remedy is possible. It should, however, be remembered that such attacks always take place on a larger scale in pure forest than in a mixed one, as the caterpillars have no difficulty in the former of obtaining as much food as they require, and a judicious mixture of the Sissu and mulberry would no doubt have the

effect of checking this pest. I have said above that here and there the webs were to be seen on mulberry trees interspersed amongst the Sissu, but in no case did my observations show me that the mulberry leaves were being eaten. It is not improbable that the mulberry was merely used as a stepping-stone from one Sissu to the next.

Points in the life history requiring further observation:—

1. In what stage, egg, larva, pupa, or moth does the insect pass through the winter?
2. The duration of the first generation of the larva. The time when they first appear on the leaves should be ascertained.
3. What happens to the moths which appear early in May? Where and when do they lay eggs, and when do the eggs hatch out? If in May or commencement of June, the length of time passed in the different stages of the subsequent generations requires watching.
4. Number of generations passed through in the year.

OCHROPHARA MONTANA,[1]

DISTANT.

Reference :—Trans. Ent. Soc. Lond., pt. I, pp. 165, 166 (1900).

Classification :—Order, **HEMIPTERA.** Family, **Pentatomidæ.**

Description.

Adult insect. Ochraceous, somewhat thickly and darkly punctate ; lateral margins of the corium, apex of the scutellum and a faint central fascia to same, body beneath, legs, rostrum, and antennæ pale ochraceous; fourth and fifth joints of antennæ reddish-ochraceous.

Body elongate: second joint of antennæ shorter than the third, third and fifth subequal in length, fourth a little longest. Lateral lobes of the head coarsely punctate, central lobe more sparingly punctate, a space before the eyes and at base, smooth. Pronotum coarsely but sparingly punctate, with a narrow central polished impression, posterior angles obtusely sub-prominent. Scutellum with a small slightly raised smooth callosity near each basal angle; basal area somewhat transversely wrinkled. Membrane pale greyish. Length. 12-13 millim.

The species is of the most extraordinary variability, not only as regards markings, which are not abnormal, but exhibiting a plastic mobility in structure which is very unusual.

Pl. I, fig. 6, shows, *a*, young wingless larva ; *b*, winged adult of this insect.

Life History.

This insect does damage in both the larval and imago stages of its life. The present information on its life history is, however, very meagre. It is reported to have appeared in enormous numbers over a portion of the Central Provinces at the

---

[1] Specimens of this insect with all that is at present known of its life history were sent me by Mr. A. E. Lowrie, Deputy Conservator of Forests, in charge of the Chanda Division of the Central Provinces. At the time the insects were swarming in enormous numbers and destroying the crop of seed of the bamboo, *Dendrocalamus strictus*.

beginning of January 1900, and fed voraciously from the middle of the month right on through February into March. Specimens I received, taken about the second week in March, consisted of both larvæ and imagos of the pest, but I am unable to state whether both stages were present in January and February. Heavy rain during the latter part of February was said to have killed off the greater number of the insects, but a few were still to be found in the third week in March.

This appears to be all that is at present known of the life history of this pest, which was described for the first time in 1900.

Areas from which reported.

Distant in his description of the insect in the Transactions of the Entomological Society of London gives its habitat as the Naga Hills, Tavoy, and Karen Hills. To these must be now added the Central Provinces.

Relations to the Forest.

This insect proved itself to be a most serious pest during the cold weather of 1901. There was a very general flowering of the bamboo, *Dendrocalamus strictus*, during this period throughout the Chanda district (it is said owing to the drought experienced during the year), over an area of some 1,200 square miles. Just before the seed began to ripen this bug appeared on the bamboos, swarming over every clump, and commenced sucking up the sap of the young newly forming seeds. Four to six weeks were occupied in this way, with the result that the entire crop of seed was ruined over this area. Having finished off the bamboo seed, the insects were said to have descended on to the *Jawari* crop then ripening in the fields and to have done damage to that.

Protection and Remedies.

It is not possible to prescribe remedies for this pest until we know something more about its life history.

Points in the life history requiring further observation:—

1. Where and when the eggs are laid and length of time spent in this stage?

2. Date on which the young larvæ first make their appearance and the plants they feed upon.
3. Length of time spent in the larval stage.
4. Dates of appearance of imagos and length of time spent in this stage.
5. The number of generations in the year. If more than one, the length of time spent in each.

CERATOPACHYS VARIABILIS,[1]

DALLAS.

Reference :—Dallas, Cat. Hemip. Ins. Brit. Mus., Pts. I & II, p. 502.

Classification :—Order, **HEMIPTERA**. Family, **Coreidæ**.

Description.

The eggs of this insect when first laid are of a brilliant green colour which later on turns to reddish green. The imago varies in colouring. The following three varieties are described :—

Var. α, ♂. Head, thorax, and body beneath pale green. Eyes and ocelli red. Thorax thickly and finely punctured with the posterior margin reddish. Coriaceous portion of the elytra thickly punctured, red, with the outer margin green, a narrow fulvous line on the apical margin, and a small yellow spot in the inner apical angle; membrane blackish brown. Margins of the abdomen pale green, with indistinct blackish bands at the posterior margins of some of the segments. Thighs greenish, with the apex brown; tibiæ and tarsi brown. Rostrum greenish, with the tip black. Antennæ black, with the second and third joints pale green at the base; third joint much dilated at the apex.

Var. β, ♀. Head, thorax, and body beneath orange. Head reddish in front. Thorax with the lateral margins and a broad band across the posterior margin red. Scutellum yellow, tinged with green. Coriaceous portion of the elytra thickly and finely punctured, greenish testaceous, with the basal portion of the outer margin yellow, and a broad red band running along the whole inner and apical margin; inner apical angle with a yellow spot. Margins of the abdomen very indistinctly marked with red at the posterior margins of some of the seg-

[1] The notes on the life history of this insect are from observations made by Munshi Fazl Din, Khan Bahadur, Extra-Assistant Conservator of Forests, in charge of the Montgomery Division, forwarded to me by Mr. C. F. Elliott, late Conservator of Forests, Punjab.

ments. Breast greenish. Basal portion of the thighs fulvous. Base of the second and third joints of the antennæ pale yellow. In other respects like var. *α*.

Var. *γ*. Head red. Thorax and under-side of the body as in the preceding. Scutellum deep orange. Coriaceous portion of the elytra pale olive, thickly and finely punctured with black with the nervures blackish; the basal portion of the outer margin and a spot in the inner apical angle yellow. Margins of the abdomen reddish, with a black band at the posterior margin of each segment. Thighs orange, with the apex pitchy; tibiæ and tarsi pitchy black. Rostrum orange, with the apical joint brown. Antennæ as in var. *β*.

Pl. I, fig. 5 shows a dorsal and side view of this insect.

Life History.

Early in February the young larvæ of this pest make their appearance and commence to feed by sucking the juices of the host plant. By the middle of March they are full grown and coupling takes place. It has not yet been recorded when the eggs from these females are laid, nor how many generations of the insect there are between these March imagos and those which are to be found in November. It is stated, however, that both larvæ and imagos are to be found attacking coppice shoots throughout the year with the exception of a couple of months in the cold weather. There is likely to be therefore more than one generation of the pest between the March and November fully-developed bugs. On the 6th November insects were found coupling, and on the 13th of the month eggs were laid; each ♀ laid from 6 to 10, and these hatched out on the 25th. Unfortunatly they all died on the 7th December, the parents having died off soon after the young had hatched out. The eggs are laid deep down in the hollows of the coppice stumps, in crevices of bark, etc., the dead bodies of the ♀ insects being found in these positions after egg-laying is over. Observation has shown that the young ones hatched out in November spend the two winter months hidden away in hollows in the coppice stools of the host plant or attach themselves to the roots or hide under bark, pieces of waste wood, etc., lying about on the

ground. They are also to be found hibernating in the thicker coppice bushes. They commence feeding again in February and become fully developed in March.

The length of time spent in the larval stages, after hatching out from the egg, to the time when the insect becomes fully developed is said to be as follows :—

Time spent as a wingless larva	two weeks.
Do. do, with rudiments of wings . .	,, ,,
Wings developing from rudiments to fully developed	three ,,

The insect now flies well and coupling takes place. When in this condition the tips of the abdomen are joined together and the insects only crawl about and do not fly even if frightened. The coupling season is said to last six weeks. Thus seven weeks are spent as a larva and about three in the imago stage, that is, if the summer generations of the imagos die off within a fortnight of laying their eggs as is the case with the November one. This would give 10 weeks for one generation with the exception of the November one, which takes about 14 weeks since the insects hibernate for a portion of the winter.

The pest is said to become scarce during the rainy season if heavy rain occurs.

Areas from which reported.

The insect has been reported from the Montgomery division in the Punjab as damaging coppice shoots.

Specimens in the British Museum (Capt. Boy's collection) are labelled as collected in North-West India.

Relations to the Forest.

This insect has appeared in large numbers on Jhand (*Prosopis spicigera*) coppice in the Montgomery division. It attacks the shoots in all its stages, sucking up the juices of the plants and only ceases its depredations for about a couple of months—December and January—in the cold weather. The insects prefer the tips of the young new shoots and commence work in February on the young shoots arising from stools felled over in the previous December. The insect sucks the sap and the leaves become colourless and dry and fall, and the ends of the shoots turn mud-coloured and die back. The coppice

growth is thus retarded a year. The damage done in two-year old coppice is said to be inconsiderable.

Protection and Remedies.

According to present observations the insect apparently passes the winter in the larval stage hidden away in the stumps or roots of the stools. An experiment might be made of washing some of them over with a kerosene emulsion solution two or three times during December and January, taking care that the solution reaches the insects. This, if done carefully, should be sufficient to kill off the larvæ. The solution is made as follows:—

Violently churn together two parts of kerosene oil, the purer the better, with one part of milk, or better, soap solution. The soap solution is made by boiling about a pound of common yellow soap with a gallon of water and then mixing with the kerosene until a thick cream is produced. Add about 12 parts of water and spray on to the stools. An ordinary watering can might be used in the trial attempts. The stools should not be soaked: only the amount of the solution necessary to reach the insects should be sprayed on.

Points in the life history requiring further observation:—

1. Number of generations passed through during the year and length of time spent in passing through each generation.
2. The insects are said to hibernate at the roots in the winter. Are they to be found on the roots at any other period of the year?
3. Do the insects confine themselves to the one year old coppice throughout the year?
4. What other trees, shoots, etc., are attacked by the pest?

PSYLLA OBSOLETA,

BUCKTON.

Reference :—Ind Mus. Notes V. 2. 35. 36.

Classification :—Order, **HEMIPTERA**. Family, **Psyllidæ**.

Description.

Antennæ filiform obscurely ten-jointed, basal joint large. Apex with two minute bristles. Thorax robust with two small spines underneath. Ferruginous in colour above, shining black below. Abdomen similarly coloured and having rings with pale edges. Forewings veined, transparent, and placed in a roof-shaped manner over the body when at rest; they are much longer than body. Hind wings obsolete or represented by mere membranous flaps. Pl. VI, fig. 5, shows, a, the winged insect, and b, gall formed by larva on leaf.

Life History.[1]

This insect forms small galls on the leaves of a forest tree. These galls are yellowish-red, rough, and have the appearance of the galls known as oak spangles which are to be found on oak leaves in England. The galls are apparently ripe, *i.e.*, the insects in them are mature and quit their abode in January and February. Although the insects were abroad under the trees at the time the samples of galls were taken and sent to Mr. Buckton for identification, none of them were perforated and the method by which the insect leaves the gall has still to be observed. When first emerging from the pupæ the insects are uniformly pale coloured. The colours darken afterwards.

Relations to the Forest.

So far as at present observed, the damage done appears to be entirely to the younger plants of *Diospyros melanoxylon.*

---

[1] This insect was discovered on the leaves of the *Diospyros melanoxylon* tree in the Shahapur taluka of the South Thana Forest Division by Mr. G. M. Ryan, Deputy Conservator of Forests, and sent to Mr. Buckton, F.R.S., for identification.

The leaves of young plants of some 6-7 years old and 3-4 feet high are attacked, the young larvæ sucking the tissues and by the irritation thus produced a gall growth arises on the leaf. After the insects have deserted the galls, the latter disappear, leaving holes all over the leaf. Mr. Ryan states that he has seen the leaves of larger trees, 8 to 10 feet high, attacked in this manner, but the damage done, so far as at present observed, would appear to be slight.

This is all that is at present known of this Psyllid. Its life history during the rest of the year has yet to be studied. The eggs are presumably laid on the young leaves or in the angle of a bud, and the time when the you-, larvæ first appear on the leaves and the length of time they spend sucking their juices requires to be noted upon.

ALEURODES EUGENIÆ,

MASKELL.

Reference:—Ind. Mus. Notes IV, 2, 52.

Classification:—Order, HEMIPTERA. Family, Aleurodidæ.

Description.

The *larva* is elliptical, very slightly convex dorsally, flat beneath: colour dull white; length about 1 millim. $=\frac{1}{25}$ inch.

A faint indication of the enclosed insect may be made out beneath the wax with which it is surrounded, but in this stage it is not conspicuous.

Pupa elliptical, slightly convex dorsally, flat beneath: colour of waxy covering very pale, dull yellow; the enclosed insect is dark brown, and its outline may be made out beneath the wax; length of test about $\frac{1}{20}$ inch. Dorsally, the test is very finely striated, the striations being most distinct near the margin. There is no marginal fringe. On turning over the test, the rudimentary feet may be clearly seen, folded inwards, and the antennæ much more faintly: the abdomen tapers posteriorly to the usual vase-shaped orifice which is common to the genus. Pl. VI, fig. 6, shows a ventral view of the pupa of this insect.

The adult form is as yet unknown. It is likely to be a small white fly, the wings of which will be more or less floury and possibly slightly spotted.

Life History, etc.

Little appears to be known concerning the life history of this small insect which, until discovered by Mr. Marshall Woodrow in Poona, was unknown to science.

The insect infests *Eugenia jambolana* trees in Poona and is said to very considerably injure them. Both larvæ and pupæ are to be found in February on the trees.

The adult insect and the subsequent life history of this small pest during the rest of the year require further careful observation.

FIORINIA THEÆ,

GREEN.

Reference :—Ind. Mus. Notes V. 1, 3-4. Pl. I. 4-8.

Classification :—Order, HEMIPTERA. Family, Coccidæ.

Description.

The pale yellow eggs are deposited in two rows within the hinder part of the female scale, the ♀ insect shrinking up after oviposition and occupying the anterior extremity only.

♀. The adult ♀ is pale yellow and is blunt elliptical in shape.

The antennæ are close together, on the anterior margin; each antennæ consists of an irregular tubercle with a single curved bristle on one side. From between the antennæ springs a proboscis-like projection which is not chitinous but of the same consistency as the surrounding parts of the body. The margin of the thorax and abdomen has a series of minute spinneret ducts opening on to small conical tubercles. The scale of the female completely encloses the adult insect and is without any secretionary margin. It is elongate and narrow in shape with a moderately distinct median ridge. Colour bright castaneous to dark ferruginous brown, the median longitudinal area darkest: opaque; not revealing the form of the insect beneath. Length 1·25 to 1·50 millim. Breadth 0·50 millim. The insects found by the writer when alive were covered with white filamentous hairy matter, the stems and leaves of the host plant appearing to be covered with a white fluffy wool. Neither the male scale nor the adult male have yet been discovered.

Pl. VI, fig. 7, shows a, portion of a leaf with insects *in situ* b, scale of adult ♀ and c, ventral surface of adult ♀.

Life History.

The writer found this scale insect on the Olive (*Olea glandulifera*) at the end of June in the Bashahr State close to Kilba in the Sutlej Valley. The ♀ insects were thickly

clustered on both the under and upper sides of the leaves being more numerous on the former. They were also gathered thickly on the stems, especially at the juncture of the leaves with the stem. The coccids had their probosces firmly fixed in the tissue of the leaves and stems and were engaged in sucking up the sap.

As a result of the attack, the leaves and stems of the Olive trees turned yellow, the former dropping off.

This insect was first discovered [1] in 1899 by Dr. George Watt on tea bushes in the Kangra Valley and Assam. It will be most interesting to find out what trees it attacks in the latter Province in addition to the tea plant and also its complete life history throughout the year.

[1] The insect was determined as a species new to Science by Mr. E. E. Green, Government Entomologist, Ceylon. Mr. Green very kindly identified my species for me as identical with Dr. Watt's.

MONOPHLEBUS STEBBINGII,[1]

GREEN.

Reference :—Green in litt.

Classification :—Order, **HEMIPTERA**. Family, **Coccidæ**, Sub-Family, **Monophlebinæ**

Description.

When this insect first appears on the leaves of the host plant, probably soon after leaving the egg, it is a minute little coccid covered with white woolly hair. Soon afterwards as it increases a little in size, the larva loses this hair and is yellow in colour, changing to a yellow-brown. At this stage it is still less than one-sixteenth of an inch in size. A fortnight later the brown colouring becomes more pronounced, the scale being then about $\frac{1}{12}$th of an inch long, elliptical in shape, convex on dorsal surface, and flat beneath, with three pairs of black legs, black antennæ, and a longish black proboscis. After a further period of fifteen days has elapsed the larvæ are about $\frac{1}{8}$th inch in length, dark brown on the dorsal surface, changing to orange yellow or pale canary yellow in the older specimens; ventral surface canary yellow; legs, antennæ, and proboscis black. This colouring remains much the same till the insect reaches maturity, but the whole of the upper surface becomes, when the scale is about a third of its full size, covered with a white powdery mealy scurf. This larva is the female one only. Both sexes are full grown and mature in April.

Wingless ♀. In general appearance the full grown ♀ is a thick, fleshy, white insect with three pairs of black legs, a pair of

---

1 The observations and notes given here are mostly my own, but in many cases they are corroborated by those of Messrs. Oliver and Milward, who have watched this insect for the last two and three years, respectively, and by planters in the district who have known the insect locally for some years.

I am indebted to Mr. Oliver for drawing my attention to the insect in the first instance on my arrival in the Dun early in 1901.

black antennæ, inserted ventrally and not dorsally, and a black proboscis tucked away on the under surface of the body. Elliptical in shape, being convex on the dorsal surface, and consisting of twelve segments in all. When rubbed, so as to remove some of the powdery material which gives the scale its white appearance, the body is seen to be dark yellow to light reddish-brown in colour. As seen on a dorsal view a white filamentous edging runs round the contour of the insect when alive and unrubbed. Size when fully grown is $\frac{3}{4}$ inch long and $\frac{1}{2}$ inch or a little less in greatest breadth. The ♀ is apparently sexually perfect before it attains its full size, a few amongst those noticed pairing being only about $\frac{1}{2}$ inch in length and dark brown to brownish-red in colour with no white powdery mantle over them. Pl. I, fig. 7, shows the wingless female insect.

Winged ♂. A small insect with one pair of black wings. Antennæ long, consisting of from 19—20 joints, black with the joints swollen in the middle and a single circular row of longish, stiff, bristly hairs arising from the thickest portion of the joint. The antennæ, as ordinarily seen on the insect in life, appear to be white and feathered ; this is simply due to the fact that the hairs become covered with the white powdery substance with which the dorsal surface of the wingless ♀ is covered. The body is red and flattened and terminates in three abdominal appendages on either side of the posterior end. The male has no mouth parts. It is very active and flies about freely. Length $\frac{1}{8}$th inch. Wing expanse $\frac{1}{2}$ inch. Pl. I, fig. 8, shows the male insect of *Monophlebus dalbergiæ* to which that of *M. Stebbingii* is very similar.

Life History.

The young ♀ larvæ are to be found early in January on the leaves of the sál and in dry years, such as the present (1902), they doubtless first appear in November or December. They are usually clustered on the midrib both on the upper and underside of the leaves, but more usually the latter, their probosces being buried in the tissue of the rib. Soon after losing the white hair, with which they apparently start life, the little scales undergo their first moult and the little whitish papery cast skins can be found stuck to the leaves by the copious sugary

secretion excreted by these insects. The female larva appears to spend from six to eight weeks feeding in this position and then descends to the young twigs. Soon after this change in position is made a further cast of skin takes place. When moulting, or shedding its skin, the latter is ruptured at the anterior end of the insect at a horizontal line of cleavage just above the insertion of the antennæ extending to the first segment of the thorax on either side. At the same time the skin ruptures from a central point in this horizontal line of cleavage down to the end of the thoracic segments on the dorsal surface and to the coxæ of the first pair of legs on the ventral surface. The insect then slowly crawls out of the old skin. Consequently on the underside of the discarded skin the black empty leg and antennal cases are to be found.

On the twigs the insects, when numerous, collect in clusters and thickly cover the young thin-barked portions; they also descend lower down and gather in knots at wounds or cracks in the thicker bark below. The insects are about ⅛th of an inch in size when they first descend to the twigs. From now onwards their growth becomes more rapid, at least one more casting of the skin taking place, until they mature towards the end of March or middle of April. When mature, twigs and branches may be seen with 6—9 inches of their length covered with white clusters of these insects, looking as if encrusted with snow, the scales lying one on top of another, often tipped up at an angle and resting on a companion below: each has its proboscis firmly fixed in the bark and is occupied in sucking up the juices. During their whole life they are very active and march about a great deal over the tree, and they excrete during the whole of this period copious amounts of a sugary secretion. This covers the leaves and twigs, clogs up the stomata, and runs down the branches, dripping down on to the ground below in enormous quantities when the insects are plentiful. The male larva has not yet been discovered, but the ♂ imago appears on the wing in April, perhaps earlier in dry years. It is not so plentiful as the female and fertilizes more than one of these latter. It is an active little insect, flying about over the serried masses of females or walking over the backs of the thick clusters. Pairing

continues for about three weeks. The method of operation is as follows. The insect flies up to a female and alights on her back and then forces itself under her between her ventral surface and the twig on which she is sitting, turning on its back in doing so. It then pushes its anal appendages into the anal ventral opening in the female. When attached to her its head is usually facing in the opposite direction to which she is sitting.

After fertilization the ♀ scales apparently cease feeding and march down the tree to search for convenient places to deposit their eggs. Towards the end of April, in badly infested areas, large numbers of the insects may be seen marching about in this way. The eggs have not yet been found, but I am of opinion that they are laid in the crowns of the trees and the perambulations of the fertilized females are probably undertaken with the object of finding unattacked trees or branches on which to lay them. Where they are very numerous the crowns of the trees are so thickly covered with the sugary secretion that it is unlikely they would choose such positions for egg-laying.[1]

The insects disappear about the end of May, in dry years at the beginning of this month.[2] A few are still to be found in June, and even in August and September a very few full-sized ♀ scales have been found, but these are in all probability unfertilized females which had managed to linger on.

Areas from which reported.

The at present known habitat of this insect is the drier portions of the sál forests on the Siwalik Range of Hills running from the Ganges on the east to the Kalesar forest, situated on

---

[1] I have recently (May 1902) obtained eggs from fertilized females kept under observation. They are apparently very often laid under the rough bark of the sál trees.

[2] The dates of first appearance of the young larvæ, and consequently of the culminating point of the attack when the insects are mature, depend on the climatic conditions to which the insects are exposed. The winter of 1901-1902 has been exceptionally mild, and the scales are at least a month more forward in their development than they were at the corresponding period of 1900-1901.

the western bank of the Jumna river, on the west. No reports[1] of its presence have yet been made from the Ganges Division to the east of the Ganges River.

Mr. Milward gives the following distribution for the forests of the Dehra Dun Division situated on the northern slopes of the Siwaliks:—

"The areas in the Dun Government forests which are subject to the severest attacks are those in the dry Western Dun. In each of the three years 1899—1901 in which it has been noticed it has been particularly active on the Siwalik's side in compartments 9 and 10 of the Jumna Range, but it has also been found in large numbers also between the Saharanpur-Chakrata road and Malhan village. It was in enormous numbers in Dholkot forest in 1900 and in the same forest chiefly at the Selakni end of it in 1901. It was also in large numbers in parts of Chandpur and Ambari forests in the latter year. Iu the damper Eastern Dun forests it has not been seen as a pest in the last three years, but in small numbers in the Ganges Range in 1899 aud 1901. It has never been seen in the Tirsal Range."

The young scales were found in enormous numbers in January of the present year (1902) in the Lakarkot forest on the southern slope of the Siwaliks, the undergrowth being thickly coated with their sugary excretion.

Relations to the Forest.

The published knowledge of the life histories and methods of attack of monophlebids[2] in Indian forests is very meagre and the present one is therefore of some interest and importance. As far as observations have yet been carried, the insect's attacks would appear to be most prejudicial to the growth of the trees, both young and old. The female scale is the chief aggressor, the mature male not feeding at all. The damage

[1] Whilst this note was in the press, the presence of this insect was reported in forests east of the Ganges by Mr. Dickinson, Conservator of the Circle.

[2] Mr. E. E. Green, Government Entomologist, Ceylon, an authority on Coccidæ, very kindly named this insect for me. Up to the date of my sending him specimens of the ♀ and ♂ insects there were but five species of the genus Monophlebus recorded from the Indian region, and of these four were described from the male insects only, the females being still unknown. To this number the writer has been able to add three new species during the past year.

arising is due to the heavy loss of sap experienced by the tree when the insects are in very large numbers. This damage arises in two ways, firstly, by the clogging up of the stomata and pores of the tree with the sugary excretion which envelops leaves, twigs, etc., with a film making them look as if they had been varnished. This is more serious in dry years when no rain falls to wash it off. Secondly, the twigs and branches dry up from the effect of the constant tapping. The crowns of large trees thus become thin and straggling under repeated attacks, whilst young saplings have a crooked method of growth, the younger ones not improbably dying down under constant repetition of the treatment. As the attack culminates in the spring when the trees are putting forth new leaves and flowers, serious injury is done to these. The development of the former is stopped and they shrivel up and wither on the smaller twigs. Information with regard to the flowers is not yet available; experiments are being carried out with seed in order to ascertain whether its vitality is impaired.

The insect prefers the crowns of the trees of the high forest, where it occasionally multiplies and congregates in enormous numbers; it is, however, to be found on small trees and saplings as well, collecting on the smaller branches and twigs or clustered for some inches up the leading shoots.

Mr. E. M. Coventry in reporting insects, which I identified as *M. Stebbingii*, from Kalesar forest at the end of April 1901, confirmed these observations relative to young growth. He wrote:—

"They are seen crawling up the trunks of large trees, but generally they are found crowded together all round the stems, sometimes for a length of six inches. The damage they do is that they sit and suck the juices of the young shoots so that the parts above dry up and drop off. The leading shoots are generally attacked in this way, so that very often the trees become crooked. I have been trying to find some coppice shoots or young saplings that have escaped injury, but every one I have seen shows signs of having been attacked in this way. When the leading shoot is killed, next year several new shoots are put out a little lower down. One of these probably takes the lead and is killed in its turn, and so on. The result is a more or less crooked habit of growth."

In parts of the Dun forests the scale insect was accompanied

in April 1901 by a looper caterpillar, the larva of the moth *Boarmia selenaria*, which entirely stripped the sál trees of leaves, flowers and green shoots.

Protection and Remedies.

No natural enemies of this scale have been as yet observed attacking the insect in the forest.[1]

Following the famous precedent of the introduction of a ladybird beetle into Florida to exterminate the fluted scale which was rapidly ruining the orange and citron industry by killing off the trees, I am endeavouring to obtain colonies of likely beetles of this family to introduce into the sál forests. Both *Vedalia cardinalis* and *Vedalia fumida* var. *roseipennis* will be experimented with with this object.

Points in the life history requiring further observation:—

1. When the eggs are laid, their number, and the time spent in this stage (see above).
2. When the ♀ larva makes its first appearance.
3. When the ♂ larva first appears, where it lives, what it feeds upon, and when and where it undergoes its transformations into the imago state.
4. The number of generations in the year.
5. In many of the forests where this scale appears, if not in all, the branches of the trees have curious knotty swellings on them. Are these swellings the result of the coccid's attack, and, if so, how do they originate?

Is there any connection between these swellings and the method and position of egg laying by the females?

Is the second stage of the life history of this insect passed within the tissues of the bark, and are these swellings connected with this second stage?

[1] Since this note was written I have spent some time further studying this scale which has been very abundant again this year (1902). Many new facts regarding its life history have been observed, not the least important of which being the discovery that the pest is most heavily preyed upon by a occinellid beetle and its larva.

MONOPHLEBUS DALBERGIÆ,

GREEN.

References:—Green in litt.

Classification:—Order, HEMIPTERA. Family, **Coccidæ**. Sub-Family, Monophlebinæ.

Description.

The following are rough descriptions made when the insects were taken, and whilst they were still alive. The writer was fortunate enough to secure both the male and female coccids.

♀ Light orange-yellow in colour but covered with a white mealy substance. Legs black, antennæ and eyes black. Greatly resembles the ♀ of *M. Stebbingii* already described in these notes (see Pl. I, fig. 7.)

♂ Winged form. Wings black, rounded at angles and with a spread of a little over ¾ inch. Antennæ nearly ½ inch in length, black, much flattened and with bristly hairs running up them. Head, thorax, and body light red in colour. Legs black. Appendages to end of body 8 in number, 3 large ones on either side, and 2 shorter ones. Pl. I, fig. 8, shows the ♂ of this insect.

Life History.

Very little is at present known on the subject of the life history of this insect. Mature winged males and apterous females were found on Sissu trees growing in the Sutlej valley. This was on the 19th June 1901. Next day further specimens were taken in the same locality higher up the river. As the writer then left the valley, he was unable to make further observations on the subject. From the portions known of the life histories of other species of *Monophlebinæ* in India it is probable that the young larvæ appear towards the end of April on the old Sissu leaves, and that as they increase in size they move down to the twigs, feeding the whole time by suction, imbibing the sap of leaves and twigs through their beaks. As the rains come on they

probably descend the tree, the females laying their eggs in crevices of the bark or on the twigs and branches.

Locality from which the insect has been reported.

The species is new to science and was discovered in June 1901 in the Sutlej valley, at elevations of between 2,300 and 3,500 feet, feeding upon the Sissu.

Relations to the Forest.

The apterous ♀ insects do damage to the tree by sucking the sap from the leaves, and more particularly the branches, thus impairing their vitality. As they increase in size, they attach themselves to the previous year's shoots, the young cortex of which they are easily able to pierce. The present species was found more especially in the two latter places, but some of the insects were still on the older leaves. When the insects are numerous the effect of the tapping reduces the vitality of the shoots which subsequently die off. In the case of large trees, the effect is bad, as their growth is considerably interfered with, but more serious damage is occasioned to young saplings, as the insects, when very numerous, cluster round the leading and side shoots and suck them dry. The tree in this case, if not killed (and the latter probably only takes place if the attack is renewed year after year) is stunted and badly shaped.

Protection and Remedies.

At present the best method known for dealing with such pests is to ascertain if it is possible to procure and introduce a natural enemy, such, for instance, as a Lady Bird beetle. This has been successfully done in the case, *e.g.*, of the scale insects on the orange trees in Florida and elsewhere, and I have hopes of being able, as our knowledge of the subject becomes greater, to work out some such remedy for our more dangerous forms of Monophlebus, one of which has already proved itself a serious pest in the sál forests of Dehra Dun and adjacent divisions.

Points in the life history requiring further observation :—

1. The month in which the young scale first makes its appearance on the old leaves of the tree. It will then be probably a minute yellow insect.

2. The month in which the insect disappears from the trees.
3. The place where the eggs are laid.
4. The abundance or otherwise of the insect. My visit was all too short to enable me to definitely ascertain this.
5. The range and elevation of the insect on the Sissu in the Sutlej valley.
6. Where the second stage of the life history is passed. Is this stage pupa-like, and is it passed in the tissues of the bark?

MONOPHLEBUS TECTONÆ ?

GREEN.

Reference:—Provisionally named by Mr. E. E. Green. The specimens of this insect obtained to date have proved insufficient to fully determine and describe it.

Classification:—Order, **HEMIPTERA.** Family, **Coccidæ.** Sub-Family, Monophlebinæ.

Description.

♀. Larva. Only from a quarter to one-third grown larvæ of this insect have yet been discovered. They much resemble externally those of *M. Stebbingii*, Green, the maturer forms being covered with the white powdery substance. A few in a more advanced condition were obtained.

♂. The male insect is not yet known in any of its stages.

Life History.

Only the younger stages of the female have yet been discovered. They were found sucking the juices from the leaves of the teak tree (*Tectona grandis*) during the latter part of July in Berar. Later on in August I found them in a more advanced stage feeding upon the twigs of the trees in the Central Provinces. I pointed the insect out to the Range Officer in the Singrampur forest of the Damoh division and he informed me that it was sometimes to be found in large numbers crowded on the twigs and branches in November. If this proves to be the case the fact is most interesting and is well worthy of the closest attention, since these insects when in large numbers are capable of greatly retarding the growth of the trees they attack, whilst at the same time often probably rendering their shape crooked and distorted.

Areas from which reported.

This insect was discovered in the Melghat forest, Berar, in July, and the next month in the Damoh division of the Central Provinces, in each case on the teak tree.

Beyond the above notes nothing is known about the life history of this *Monophlebus* which has still to be worked out. Both the ♂ and ♀ mature insects are likely to resemble externally those shown in Pl. I, figs. 7 and 8.

A Note on the Application of Paris Green as an Insecticide for destroying Caterpillars.[1]

Nature of the poison.

Paris green is an arsenical compound, very much like "London purple" both in composition and also in the effect which it has upon insects. It is more satisfactory than the latter compound as it is less liable to injure the foliage, and its use has proved safe at the rate of one pound of the Paris green to 150 (one hundred and fifty) gallons of water.

Method of preparing the mixture.

Before mixing the Paris green with water it is advisable to add an equal weight of freshly slaked lime (flour has been used instead of lime, but the latter is the better of the two, if procurable), mixing thoroughly. The lime takes up any free arsenic and prevents possible injury to the foliage.

Application of the poison.

The poison can be best applied by means of an ordinary spray pump and nozzle, and during the process of application the solution should be kept constantly stirred to prevent the poison from settling to the bottom. This is most important.

Time of application.

The worms are most readily poisoned when newly hatched, and it is therefore very important to spray as soon as the young worms first appear. This also, of course, prevents the damage which they would commit as a result of delaying. The above is a general summary of the nature and method of application of Paris green. I will now consider the question more in detail.

---

[1] This note was written at the instance of Mr. R. Wroughton, Conservator of Forests, Bombay, with the object of endeavouring to exterminate the larvæ of *Hyblæa puera* and *Pyrausta machœralis* which defoliate the young teak plants reared in the Central nursery near Poona.

Since this note went to press, I have received information that the appication of this poison as here recommended was attended with success.

Strength of the mixture.

Paris green does not dissolve in water: it is simply held in suspension. The strength of the mixture depends on the quality of the foliage to be sprayed. The teak has a thick, tough leaf even when young, and the mixture of 1 lb. of Paris green to 150 gallons of water should be tried first. If it does not appear to kill off the larvæ, it might be made stronger up to 1 lb. of Paris green to 130 gallons of water. The lime or flour used has of course no effect: it is simply to enable the Paris green to mix better whilst at the same time the lime would take up any free arsenic.

Method of mixing.

The exact method of mixing is quite immaterial, only remember that the powder should be thoroughly diffused through the water, not allowed to be in lumps. The mixture must be kept an even strength throughout. The Paris green and lime should be first mixed up with a small quantity of water, and then the rest added till the full amount has been made up. The operator should not handle or inhale the powder.

Applying the mixture.

It should be applied as a fine spray by means of a force-pump. It should be thrown so finely as to reach all parts of the tree and both sides of the leaves, and coat the leaves as with a fine dew. The foliage must not be drenched, but the spray should only be allowed to fall upon the trees until it begins to drop from the leaves. All washes containing Paris green must be kept constantly stirred to keep it in suspension, or it will sink to the bottom. This is important. The following points should be insisted on:—

(*a*) As above mentioned, keep the mixture well stirred all the time.

(*b*) Have the barrel or vessel used for the mixture well washed out after it has been filled ten or twelve times. The Paris green is very heavy and keeps sinking to the bottom. As the barrel is frequently refilled, the residue will keep accumulating until it will be too strong as the mixture reaches the bottom.

The mixture should on no account whatever be thrown so as to "swill" or "souse" the trees and run off the leaves in drops or streams. This is a bad practice in every way. It uses a great deal more of the chemical than is needed; the leaves getlittle but pure water at their highest part and much too strong an application where the fluid has settled at their tips.

Several days should elapse between the sprayings, unless, of course as may easily happen in difficulties of first experiments, the spray was manifestly so weak that the previous application counted for nothing. The effect of the Paris green on the caterpillars does not always show immediately, and it is undesirable to waste labour and material where the work is already done and requires only a day or two to show it.

Effect of the spraying.

The effect is to poison the leaves and the caterpillars feeding on them take arsenic interiorly and are thus killed. The sprayings should be discontinued as soon as it is seen that all the caterpillars are killed.

Cautions as to use of the Paris green insecticide.

Paris green is an aceto-arsenite of copper and of a poisonous nature, and therefore should be used with care in mixing. The bags of the mixture should be labelled "Poison" and kept locked up, and especially kept out of the way of children who would be attracted by the beautiful green colour of the powder.

Workers with the powder should not allow it to settle in any sore or crack in the skin of the hands, nor stir it about unnecessarily with the hands, and they should be careful not to breathe the powder through the mouth or nose, whilst measuring or mixing it.

For this reason it is desirable that purchasers of Paris green should have it sent, not in bulk, to be divided for use on receipt, but wrapped in single pound or small packages by the senders, or better still have it in the form known as "Paris green paste", that is, the powder just damped so that it cannot fly about.

How to procure the powder.

Large firms in Bombay or Calcutta, etc., will supply the arsenic. It is procurable at small cost (about Re. 1-4 per pound), and is known to the trade as "Paris-green" or "Emerald-green". I believe Messrs. Blundell, Spence & Co. (Limited) of Hull and 9, Upper Thames Street, London, England, Colour Manufacturers and Exporters, would deliver quantities of 14 lbs. and upwards at 1*s.* per pound packed in one pound paper parcels or in paste state in large glass jars of 4 to 7 lbs. at the same price. Messrs. Hemmingway & Co., of 60, Mark Lane, London, E.C., also, I believe, supply the powder.

Spraying machines.

Various spraying machines have been invented. At first it will be sufficient to use an ordinary sprayer, but the nozzle must be a very fine one, so that the application may be made as a fine spray and not as a stream. This is essential.

Should the apparatus be successful, it would be practicable to get one of the machines specially made for the purpose. Many firms make them and their catalogues could be obtained. A good one is an ordinary barrel mounted on wheels to hold, say, 36 gallons. In the rear a pump is fixed with two delivery pipes to which are attached whatever length of tubing may be required. Three men go with the apparatus, two men to spray and one to pump.

The manufacturers are Messrs. Boulton and Paul, Rose Lane Works, Norwich.

A knapsack form of sprayer known as the Chiswick Co.'s Sprayer can, I believe, be procured from the Planters' Stores and Agency Co., Ld., 3, Mission Row, Calcutta.

Spraying should not be done in a high wind.

PLATE I.

FIG. 1. BRACHYTRUPES ACHŒTINUS, Stoll. *a.* Young wingless larva ; *b.* Winged adult.

„ 2. SINOXYLON ANALE, Lesne. *a.* Larva ; *b.* pupa ; *c.* dorsal and side view of mature beetle ; *d.* Piece of sissu wood showing borings of *Sinoxylon crassum* and *S. anale* (¼ nat. size).

„ 3. TERETRIOSOMA STEBBINGII, Lewis. Dorsal and side view.

„ 4. BOTHRIDES SP. Dorsal and side view.

„ 5. CERATOPACHYS VARIABILIS, Dallas. Dorsal and side view.

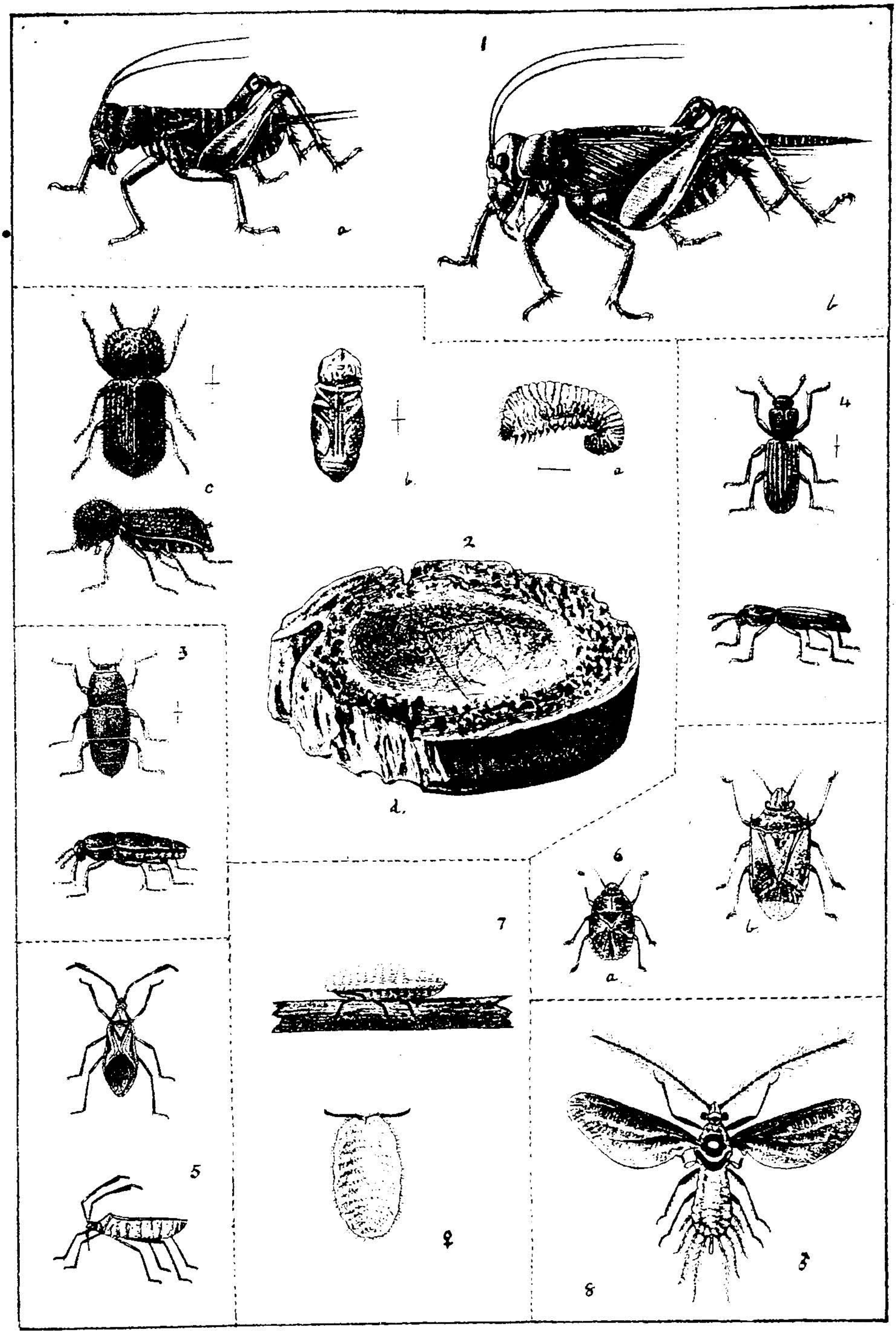
„ 6. OCHROPHARA MONTANA, Distant. *a.* Young wingless larva ; *b.* Winged adult.

„ 7. MONOPHLEBUS STEBBINGII, Green. Dorsal and side view of mature ♀.

„ 8. MONOPHLEBUS DALBERGIÆ, Green. ♂, enlarged three times. E. E. Green, del.

NOTE.—When not otherwise stated, the drawings are by Artist S. B. Mondul. Hair lines represent the actual size of the insects.

PLATE 1.



S. B. Mondul, del.

1. BRACHYTRUPES ACHŒTINUS, STOLL
2. SINOXYLON ANALE, LESNE
3. TERETRIOSOMA STEBBINGII, LEWIS.
4. BOTHRIDES SP
5. CERATOPACHYS VARIABILIS, DALLAS.
6. OCHROPHARA MONTANA, DISTANT.
7. MONOPHLEBUS STEBBINGII, GREEN.
8. MONOPHLEBUS DALBERGIAE. GREEN.

Regt. No. D. 16. ... Feby. 1903 - 600

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, March 1902.

PLATE II.

FIG. 1. PSEUDOSPHINX DISCISTRIGA, Wlk. ♂. (After Hampson).

„ 2. CLANIA CRAMERI, Westw: *a.* Larva in twig case (after Hampson); *b.* pupa of ♂ moth protruding from case; *c.* ♂ moth.

„ 3. LYMANTRIA MATHURA, Moore. *a.* ♂ moth (after Hampson); *b.* ♀ moth.

„ 4. ACRONYCTA ANÆDINA, Butl. *a.* Larva; *b.* pupa; *c.* moth.

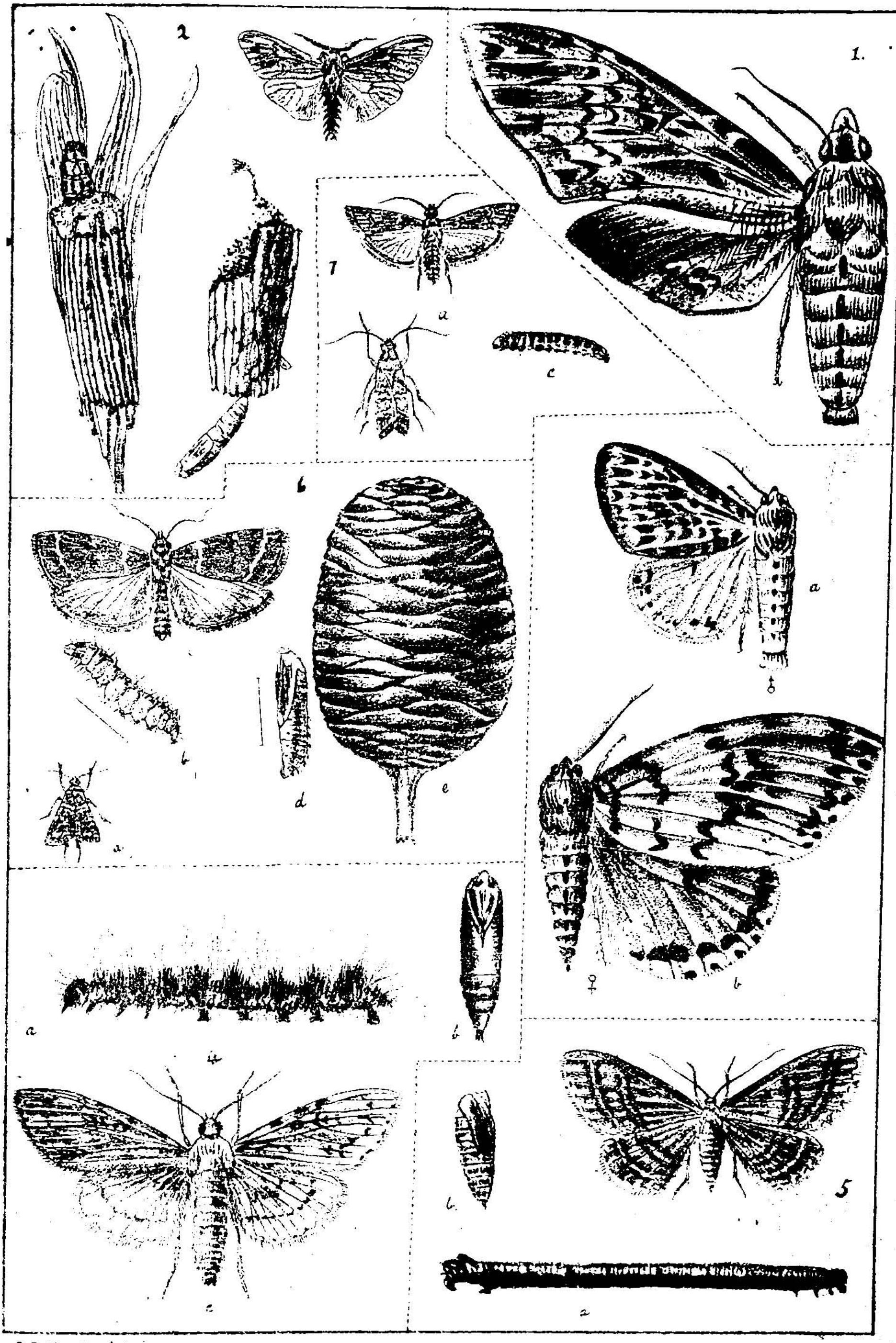
„ 5. BOARMIA SELENARIA, Hübn.; *a.* Larva; *b.* pupa; *c.* moth.

„ 6. EUZOPHERA CEDRELLA, Hmpsn. *a.* moth, nat. size and enlarged.

„ 7. PHYCITA ABIETELLA, Schiff. *a.* moth, at rest and with wings spread.

(Figs. 6 and 7:) *b, c,* larvæ from the cone. It is at present uncertain as to which larva belongs to which moth; *d.* pupa, perhaps of *E. cedrella*; *e.* Deodar cone showing borings of larvæ.

NOTE.—Hair lines represent natural size of the insects.



S.B. Mondul. del.

1. PSEUDOSPHINX DISCISTRIGA, WLK
2. CLANIA CRAMERI. WESTW.
3. LYMANTRIA MATHURA, MOORE.
4. ACRONYCTA ANAEDINA, BULT.
5. BOARMIA SELENARIA, HÜBN.
6. EUZOPHERA CEDRELLA, HMPSN.
7. PHYCITA ABIETELLA, SCHIFF.

PLATE III.

FIG. 1. APODERUS SP. *a.* Dorsal and side view of ♀ ; *b.* dorsal view of ♂ ; *c.* a new Sissu shoot showing method of defoliation by beetle for the purpose of egg laying (from a drawing by the author); *d.* Rolled up leaf containing an egg showing method of rolling adopted by insect.

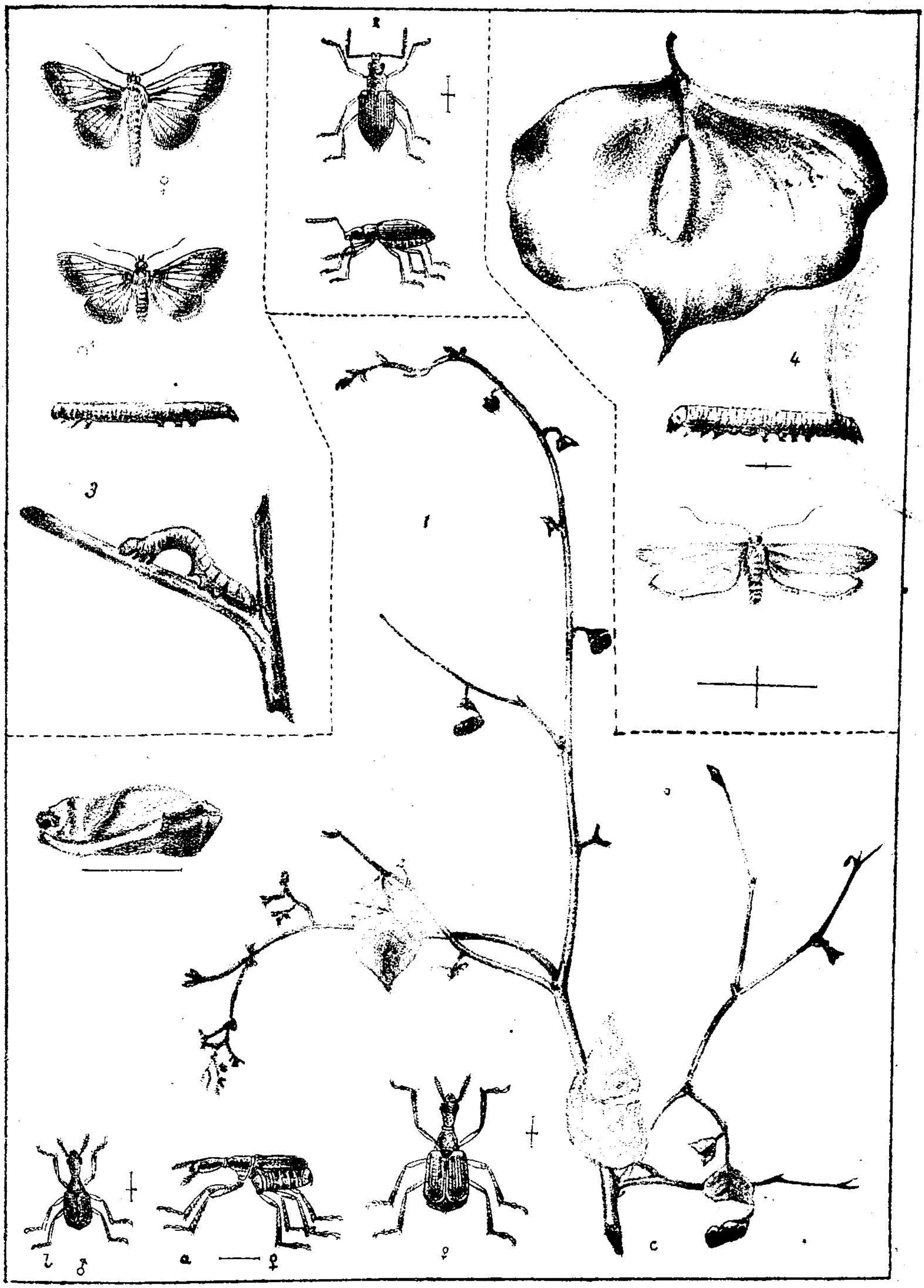
„ 2. MYLLOCERUS SP. Dorsal and side view.

„ 3. PLECOPTERA REFLEXA, Guen. *a.* Larva ; *b.* ♂ and ♀ moths.

„ 4. YPSOLOPHUS SP. *a.* Larva ; *b.* pupa, attached by fine silk hairs to the centre of a Sissu leaf ; *c.* moth.

NOTE.—Hair lines represent natural size of the insects.

PLATE, 3.



S. B. Mondul, del

1. APODERUS SP.
2. MYLLOCERUS SP.

3. PLECOPTERA REFLEXA, GUEN.
4. YPSOLOPHUS SP.

Regr. No. D. 16, I. F. 0 - Feby. 1902 - 500

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dún, March 1932.

PLATE IV.

Fig. 1. Serica Alcocki, Brenske. Imago.

" 2. Xylotrechus vicinus, L. and G. Imago.

" 3. Apriona Germari, Hope. *a.* Larva; *b.* pupa (ventral view); *c.* imago (dorsal view).

" 4. Scolytus sp. *a.* Larva; *b.* dorsal and side view of the beetle; *c.* galleries made by beetle in deodar sap wood. The horizontal gallery is the egg gallery; the vertical galleries are the larval galleries.

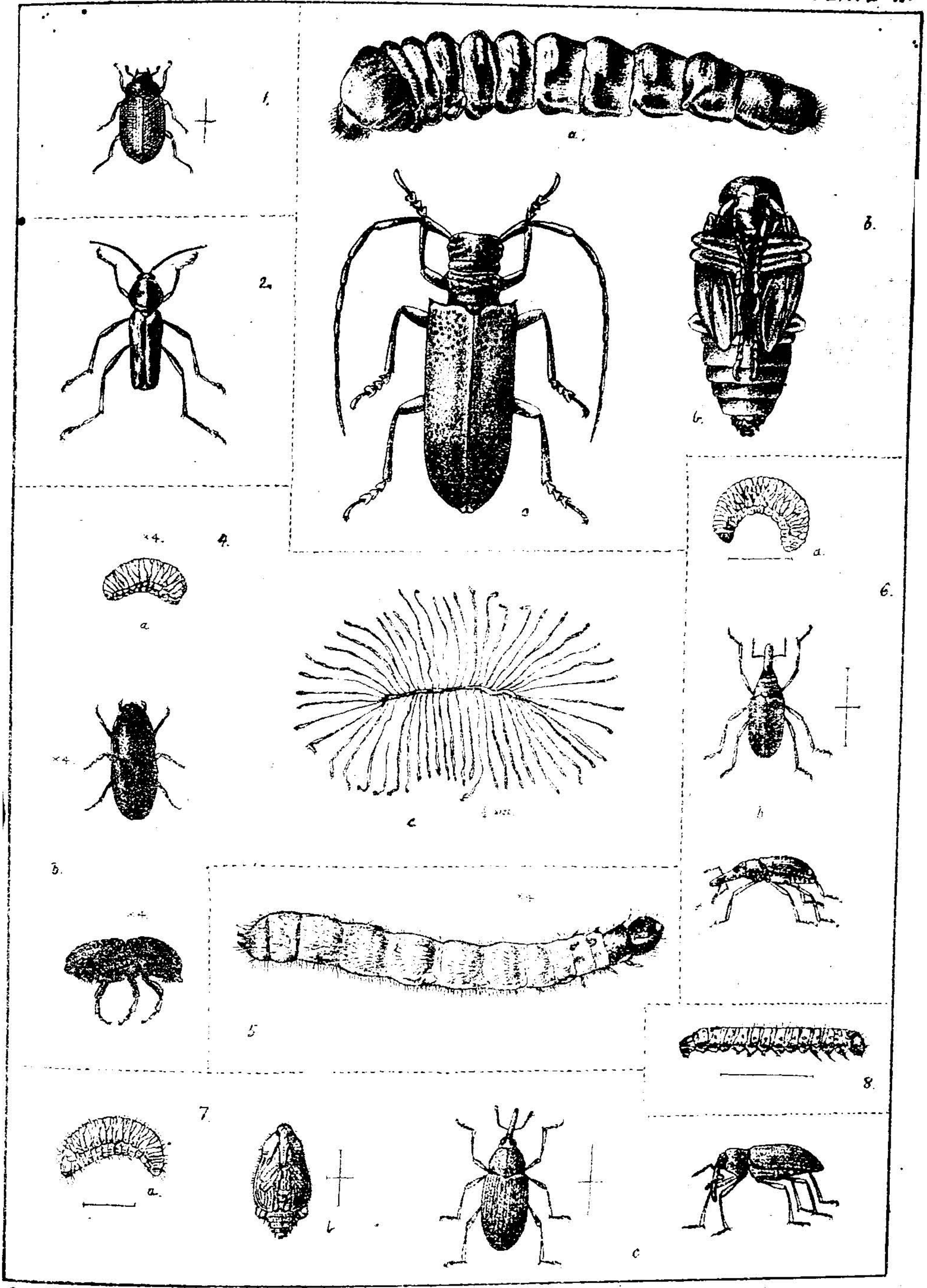
" 5. Clerid larva.

" 6. Alcides sp. *a.* Larva; *b.* dorsal and side view of beetle.

" 7. Cryptorhynchus sp. *a.* Larva; *b.* pupa; *c.* dorsal and side view of beetle.

" 8. Lepidopterous wood-boring larva.

PLATE IV.



S. B. Mondul del.

1. SERICA ALCOCKI, BRENSKE
2. XYLOTRECHUS VICINUS, L. AND G
3. APRIONA GERMARI, HOPE
4. SCOLYTUS SP.
5. A CLERID LARVA
6. ALCIDES SP.
7. CRYPTORHYNCHUS, SP.
8. A LEPIDOPTEROUS WOOD-BORING LARVA

Regr. No. ... April 1902 - 500

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, January 1902.

PLATE V.

FIG. 1. SUANA CONCOLOR, Wlk. *a.* Larva; *b.* pupal case attached to a sál twig; *c.* pupa, taken out of case; *d.* moth (moth after Hampson).

" 2. TRABALA VISHNU, Lef. Imago. (After Hampson).

" 3. PORTHESIA XANTHORRHŒA, KOLL. *a.* Imago; *b.* side view of head (after Hampson).

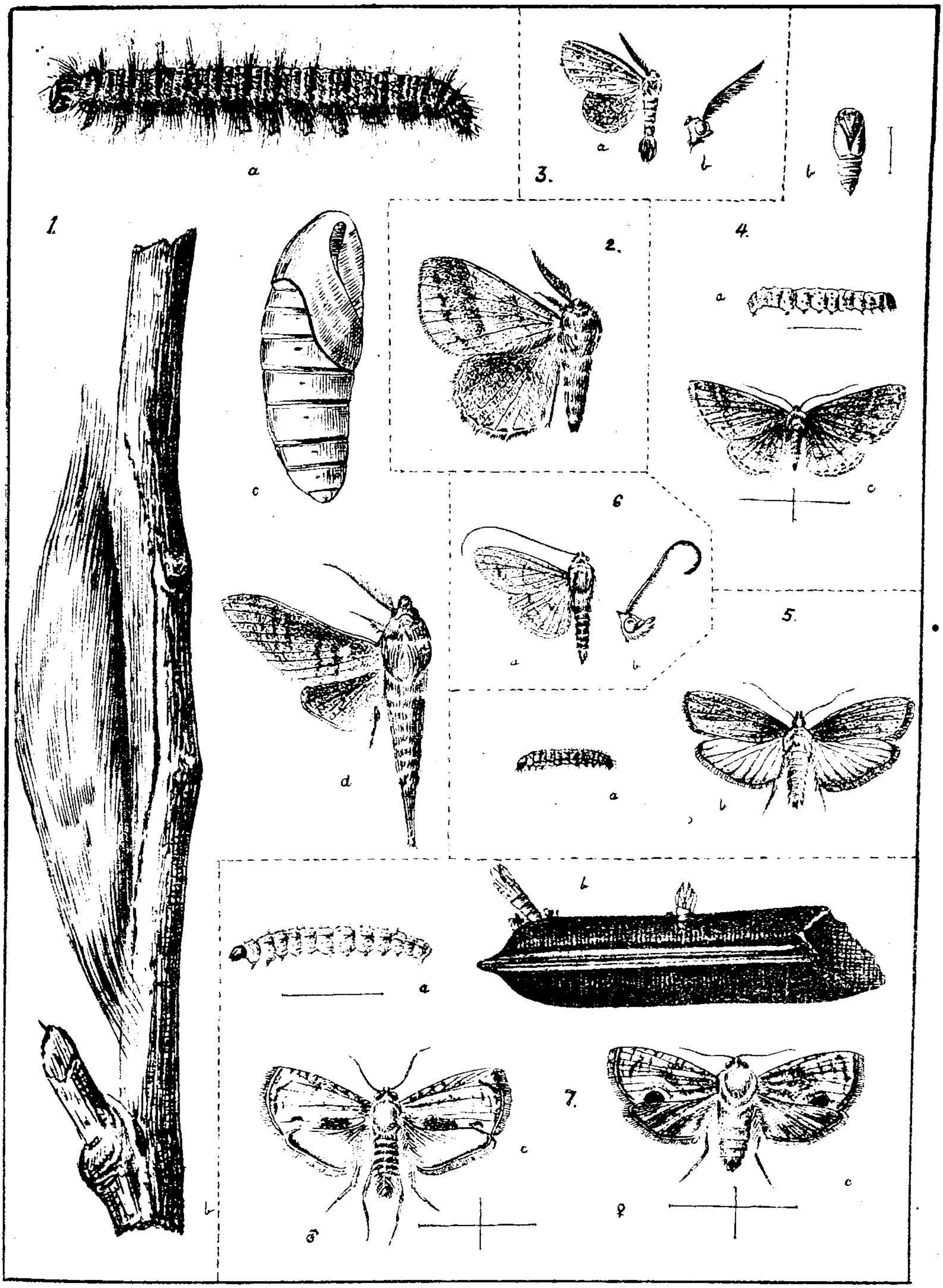
" 4. DIRADES THECLATA, Guen. *a.* larva; *b.* pupa; *c.* moth.

" 5. TRACHYLEPIDEA FRUCTICASIELLA, Rag. *a.* Larva; *b.* moth.

" 6. TETRIDIA CALETORALIS, Wlk. *a.* Imago; *b.* side view of head (after Hampson).

" 7. CRYPTOPHLEBIA CARPOPHAGA, Wlsm. *a.* larva; *b.* pupal case protruding from the bean; *c.* ♂ moth; *d.* ♀ moth.

PLATE V.



S. S. Mondul del.

1. SUANA CONCOLOR, WLK.
2. TRABALA VISHNU, LEF.
3. PORTHESIA XANTHORRHŒA, KOLL.
4. DIRADES THECLATA, GUEN.
5. TRACHYLEPIDEA FRUCTICASIELLA RAG.
6. TETRIDIA CALETORALIS, WLK.
7. CRYPTOPHLEBIA CARPOPHAGA, WLSM.

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, May 1902.

Regr. No. D. 31, I. F. O. - Mar. 1902 - 500

PLATE VI.

FIG. 1. TRYXALIS NASUTA, Fisch. Imago (side view).

,, 2. OXYA VELOX, Burm. Imago (side view).

,, 3. A MELOLONTHID larva. Side view.

,, 4. An ELATERID larva.

,, 5. PSYLLA OBSOLETA, Buckton. *a.* Winged insect ; *b.* gall formed by larva on leaf. (After Ind. Mus. Notes.)

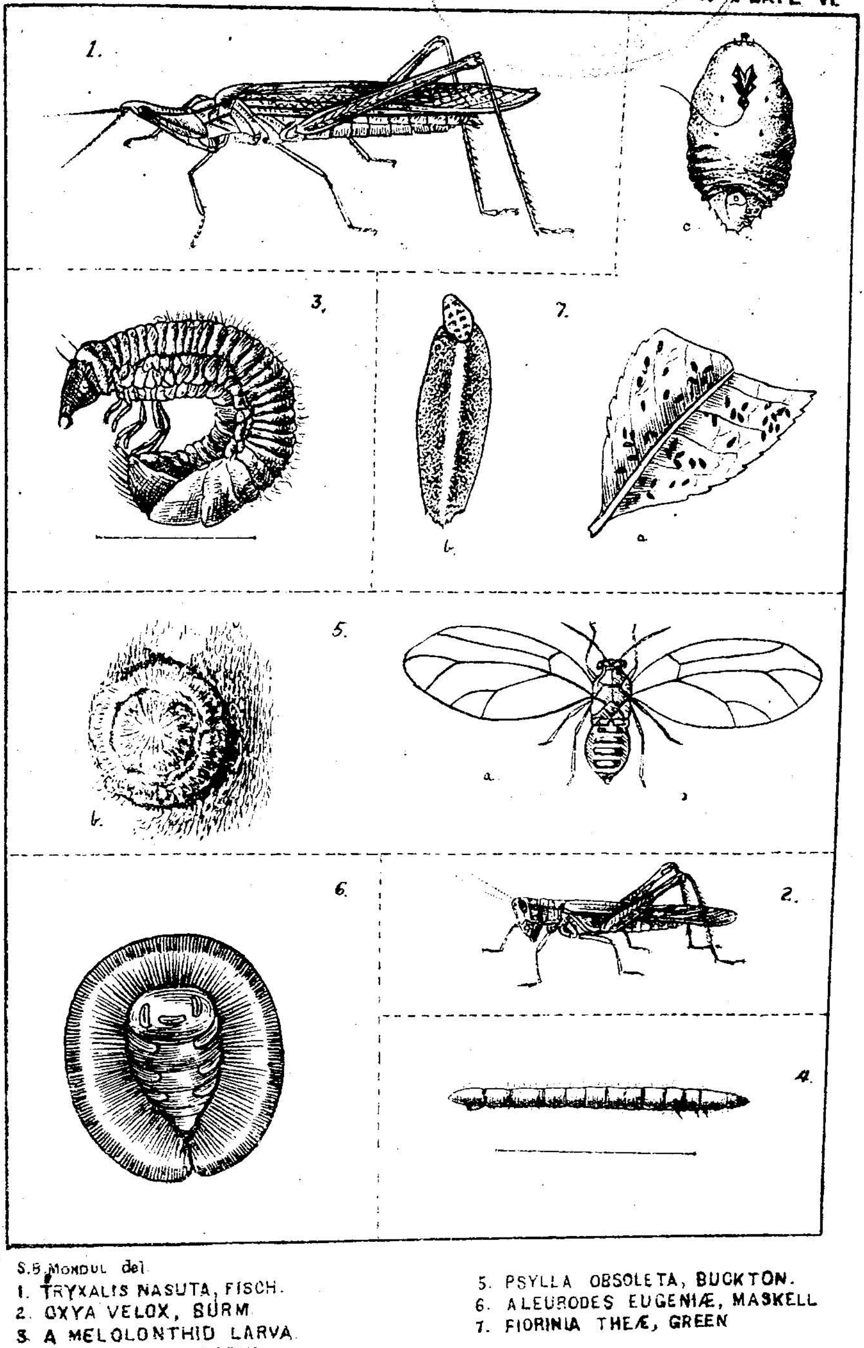
,, 6. ALEURODES EUGENIÆ, Maskell. Pupa, ventral view. (After Ind. Mus. Notes.)

,, 7. FIORINIA THEÆ, Green. *a.* Leaf with insects *in situ* (nat. size) ; *b.* scale of adult ♀ ; adult ♀, removed from scale, ventral view. (After Green.) *b.* and *c.* enlarged.

G. I. C. P. O.—No. 1169 R. & A.—18-7-1902.—500.—J. W. DeB.

18 DEC 1

PLATE VI.



S. B. MONDUL del.

1. TRYXALIS NASUTA, FISCH.
2. OXYA VELOX, BURM.
3. A MELOLONTHID LARVA.
4. AN ELATERID LARVA
5. PSYLLA OBSOLETA, BUCKTON.
6. ALEURODES EUGENIÆ, MASKELL
7. FIORINIA THEÆ, GREEN

Photozincographed at the Office of the Trigonometrical Branch, Survey of India, Dehra Dun, April 1909.

Regd. No. D. 31, I.P. O.-April 1909-600